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A STUDY OF MARKETS
FOR AIR POLLUTION MEASUREMENT INSTRUMENTATION
1971-1980

by

Rene R. Bertrand

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1. PREFACE

This analysis of the market for air pollution instrumentation during the period 1971-1980 was prepared to assist in the determination of a federal research and development plan for the fiscal years 1972-1977 to insure the timely availability of the measurement instrumentation required for the Nation's air pollution control program. The market analysis was directed toward an assessment of the potential market size and thus the expected contribution that the private sector might make to this program.

In making this assessment, an effort has been made to keep the assumptions concerning the potential application of instruments and the cost of instrumentation as conservative as possible while still maintaining a realistic view of the measurement requirements imposed by current air pollution control legislation and the author's assessment of the intent of such legislation. This conservative approach was necessary to insure that the federal air pollution instrumentation R/D plan, which this market analysis complemented, would include the provision for conducting and supporting all required instrumentation R/D, unless an overwhelming profit motive existed for support from the private sector. This approach, in all probability, has resulted in an undervaluation of the total market for air pollution instrumentation during the coming decade.

The analysis as presented in this report was essentially completed in July 1970 and was based on proposed legislation at that time before the Congress to amend the Air Quality Act of 1967. Issuance of the report was delayed to await the final outcome of the proposed legislation, in view of the major potential impact this legislation was expected to have on the market for stationary and mobile source measurement instrumentation. Minor revisions have recently been made to the report to reflect the provisions of the Clean Air Amendments of 1970 passed by Congress in December, 1970. During this revision, the opportunity was taken to make changes that reflect current federal plans for support funding to the state and local government air pollution control programs. Notations have also been added to reflect the views of several individuals that have kindly reviewed the earlier drafts of this report. These views, for the most part, put forth alternate measurement strategies or suggest additional instrumentation requirements that could greatly increase the total market for air pollution measurement instrumentation.

2. SUMMARY

This report presents an analysis of the domestic market for air pollution instrumentation for the period 1971-1980.*

The market for air pollution instrumentation during the decade of the 70's has been determined as part of a project being conducted by Esso Research and Engineering Company for the Office of Air Programs of the Environmental Protection Agency. This project has as its primary objective the delineation of a federal research and development plan for air pollution measurement instrumentation. One part of this project involved a market analysis to assess the opportunities available and thus the contribution to this R/D program that might be expected from the private sector in providing the measurement instrumentation required to assure the ability of this nation to conduct an effective air pollution control effort.

The market for three different areas requiring instruments to obtain information on the concentration level of air contaminants is discussed. These include: monitoring of the ambient air quality level, measurement of the emissions from stationary sources of air pollution, and measurement of the emissions from the automobile. The market for these areas of instrumentation is based on a review of instrumentation requirements at the federal, state, and local level and on an analysis of current legislation and air pollution control codes.

The scope of the market analysis has been limited to the sensors required to detect and measure air contaminants and special hardware required to obtain the sample. We have specifically excluded from our market estimate the quantity and value of telemetering equipment and the cost of instrument maintenance. The analysis also excludes the market for instrumentation needed for the research and development programs which will support the Nation's air pollution control program. The dollar value estimates presented in this report include, where appropriate, a device to record the pollutant concentration level.

Ambient Air Quality Level Monitoring

The market for ambient air quality level measurement equipment has been divided into two basic types of air monitors. The automatic and continuous, sample-analyzer monitors produce numerical and/or graphical information directly. The non-automatic or intermittent monitors employ collection devices and separate laboratory facilities for subsequent analysis of the sample.

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* The work reported here was performed under Contract No. CPA 22-69-154 for the Office of Air Programs of the Environmental Protection Agency. The statements and conclusions presented are those of the author and do not necessarily reflect the views of the Environmental Protection Agency.

In this study of the market for ambient air quality monitoring, we have considered only instrumentation required for the following air contaminants: particulates, sulfur dioxide, oxidants, carbon monoxide, hydrocarbons, oxides of nitrogen, fluorides, polynuclear organic matter, and odors.

The market for continuous air quality monitors during the decade, while impressive in terms of the total number of new instruments required, is fragmented into many different analyzers each with a relatively small market.

TABLE 1

SUMMARY: CONTINUOUS AMBIENT AIR
QUALITY LEVEL MONITOR REQUIREMENTS

	Instrumentation Market 1971-1980 (Units)		
Analyzer	Initial	Replacement	Total
Sulfur Dioxide	671	750	1421
Nitric Oxide	626	510	1136
Nitrogen Dioxide	744	650	1394
Carbon Monoxide	722	660	1382
Non-Methane Hydrocarbon	950	570	1520
Oxidants (Ozone)	814	620	1434
Polynuclear Organic Matter	380	110	490
Odors	867	425	1292
Automatic Tape Soiling Index	386	--	386
Particulate	570	--	570
Fluorides	380	--	380

Non-automatic air monitors will be a significant part of the total agency requirements for ambient monitoring. These monitors have the potential to be an effective means for providing a reasonable definition of air quality over urban areas as well as background pollutant levels in less polluted portions of the country. Requirements in this area include:

TABLE 2

SUMMARY: NON-AUTOMATIC AMBIENT AIR
QUALITY LEVEL MONITOR REQUIREMENTS

	Market 1971-1980 (Units)		
Collection Devices	Initial	Replacement	Total
Gas Collector Devices	16838	9578	26416
Dust Fall Collector for Settleable Particulates	6713	5643	12356
High Volume Sampler for Suspended Particulates	7233	5383	12616

Stationary Source Emission Measurements

The stationary source emission measurement market that has been estimated is based on measurements that the author anticipates will be made by industry and by the control agencies under current air quality legislation and legislative trends. The stationary source emission measurement instrumentation estimates have been based on discussions with representatives of selected industries and on an analysis that has considered: legislation, AP codes and the magnitude of the air pollution problem for a particular industry.

This market estimate for stationary source emission measurement instrumentation includes instrumentation for continuous source monitoring of the following air contaminants: particulates, sulfur dioxide, oxides of nitrogen, hydrocarbons, carbon monoxide and fluorides. Instrumentation requirements for these source emission measurements are expected to be a major fraction of the total source emission instrumentation market during the decade, although additional markets, which were not considered in this analysis, can be expected for measuring other air pollutants which are emitted from stationary sources.

Instrumentation needs in the stationary source emission measurement area include:

TABLE 3

SUMMARY: STATIONARY SOURCE EMISSION MONITORING REQUIREMENTS

Analyzer	Instrumentation Market 1971-1980 (Units)		
	Initial	Replacement	Total
Particulates	18800	5120	23920
Sulfur dioxide	3935	1075	5010
Carbon monoxide	2705	1840	4545
Hydrocarbons	4755	825	5580
Nitrogen oxides	9760	2110	11870
Fluorides	505	165	670

In addition, a market exists for 500 instruments to remotely measure the emissions from stationary sources.

Auto Emission Measurements

The potential market for auto exhaust emission measurements assumes the adoption of an annual nation-wide auto exhaust measurement program. The agency instrumentation requirements were estimated using two possible alternate inspection testing procedures. The first alternate involves an extrapolation of the state inspection lanes that would be required to inspect on a once-a-year basis each vehicle in the United States using the plans and inspection lane requirements of the State of New Jersey as a model. The second alternate involves the use of state franchised auto emission inspection facilities. Each auto emission inspection alternative investigated suggests a major instrumentation requirement.

TABLE 4

SUMMARY: AUTO EXHAUST EMISSION INSPECTION TESTING REQUIREMENTS*

Analyzer	Instrument Market 1971-1980 (Units) Initial	Replacement	Total
Carbon monoxide	4240	2968	7208
Hydrocarbon	4240	2968	7208
Nitrogen oxides	4240	2544	6784
Particulates	4240	--	4240

The auto emission measurement market also includes the purchase of measuring instrumentation by the service area segment for use by service stations and auto repair facilities to adjust the auto emission control devices of those automobiles that have been found to be unacceptably high polluters during the state inspection. This market segment provides an opportunity for the development of a low cost combined hydrocarbon-carbon monoxide instrument to measure auto exhaust emissions. In the mid to late seventies a nitrogen oxides instrument may also be required for the same market.

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* The estimates presented in Table 4 are based on conducting the auto exhaust emission measurements in state inspection lanes. The estimate of the total auto emission measurement market if inspection testing is conducted in state franchised auto emission inspection facilities is given in Tables 28 and 30.

TABLE 5

SUMMARY: AUTO EXHAUST EMISSION SERVICE AREA REQUIREMENTS

Analyzer	Market 1971-1980 (Units) Initial	Replacement	Total
Hydrocarbon-carbon monoxide (combined analyzer)	176000	35200	211200

A small market also exists for industry purchases of instrumentation to conduct end-of-the-line emission quality assurance testing.

Dollar Value of the Market

The market amounts to nearly one half billion dollars during the coming decade, some 76% of which represents initial purchases of air pollution measuring equipment. Industry will be the major purchaser of instrumentation accounting for 45% of the market. The market is heavily oriented towards stationary source emission measurement instrumentation, this area accounting for 51% of the total instrumentation market value.

TABLE 6

ESTIMATE OF AIR POLLUTION INSTRUMENTATION MARKET TOTAL VALUE 1971-1980

(Millions of Dollars)

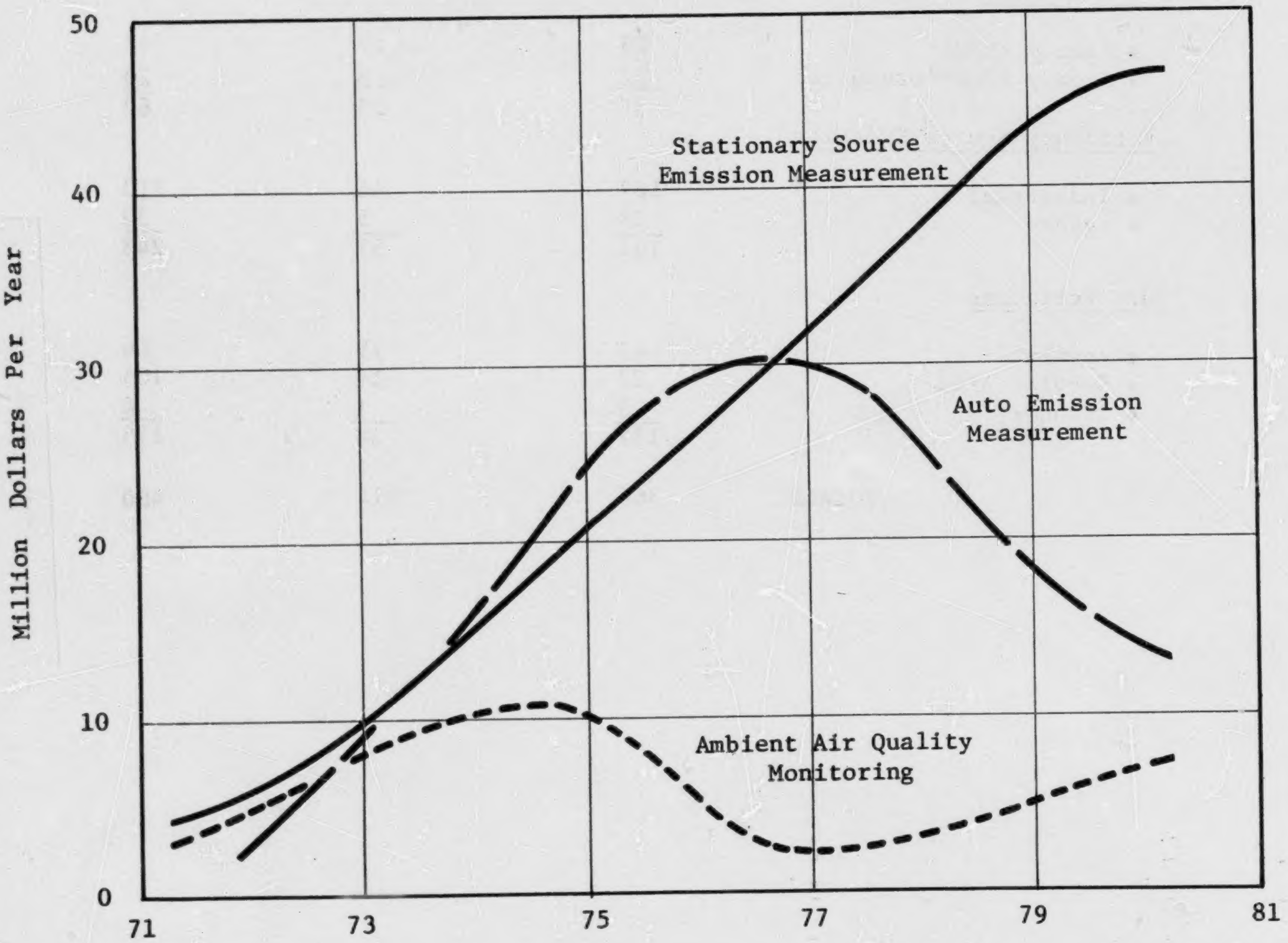
	Initial Purchase	Replacement	Totals
Ambient Level			
• Agency (CAM)	25	17	42
• Agency (Non-Automatic)	12	8	20
	37	25	62
Stationary Source Emission			
• Industrial	167	46	213
• Agency	25	5	30
	192	51	243
Auto Emissions			
• Agency	47	19	66
• Service Area	87	18	105
• Industry	3	1	4
	137	38	175
TOTALS	366	114	480

Time Frame for the Market

Timing appears to be a critical factor in the market with each of the three areas of measurement reaching maturity at different periods during the decade. The ambient air quality level monitoring market is expected to reach maturity about 1975 and the auto emission measurement instrumentation market about 1977, while the stationary source emission measurement instrumentation market will continue to grow throughout the decade.

FIGURE 1

TIME FRAME FOR THE INSTRUMENTATION MARKET



3. INTRODUCTION

The ability of this Nation to conduct an effective air pollution control program requires the means to measure the extent and level of air contaminants. The Office of Air Programs of the Environmental Protection Agency has sponsored a project with Esso Research and Engineering Company, under Contract No. CPA 22-69-154, to define those research and development efforts required to insure the timely availability of instrumention and analytical techniques needed to economically meet measurement needs in air pollution control. This project has as its primary objective the delineation of a federal plan for air pollution instrumentation and analytical techniques research and development during the time period 1972-1975. A secondary objective of this project involved a market analysis to assess the opportunities available and thus the contribution that might be expected from the private sector in providing measurement instrumentation required to conduct an effective air pollution control effort. This report presents a study of the markets for air pollution measurement instrumentation for the time period 1971-1980. The study has been based on an analysis of current legislation, control plans, and recent trends in an effort to define the potential needs in the air pollution measurement area. It is recognized that these needs may be abruptly influenced by decisions of key individuals who control supporting resources or determine policies that affect their application.

Previous Studies on the Market

Several studies have already been made of the market for air pollution measurement instrumentation. Most of these studies have been conducted for individual clients or as multi-client studies and are not available to the general public. These private studies include:

Organization Making the Study	Date of Study
Stevenson, Jordan and Harrison (Management Consultants) 200 Park Avenue New York, N.Y. 10017 Attn: Andrew Kazarinoff	1967, 1969
Frost & Sullivan 179 Broadway New York, N.Y. 10007 Attn: Joseph Levy	Yearly
Predicasts, Inc. 10550 Park Lane University Circle Cleveland, Ohio 44106 Attn: Roy Ginsburg	1968

Arthur D. Little, Inc. 1970
Acorn Park
Cambridge, Mass. 02140
Attn: Heinz Beutner

Stanford Research Institute* 1970
Menlo Park, California

There has been very little information published in the open literature concerning the magnitude of the market for air pollution measurement instrumentation. The information that has appeared includes:

Information on the Market for Air Pollution
Instrumentation Appearing in the Open Literature

Source	Date	Prediction
Optical Spectra	March 1970, p. 17	Air pollution measurement equipment sales of \$50 $\overline{M}$ in 1975
Wall Street Transcript	13 October 1969	a) 50% per year growth rate for air pollution measurement equipment between 1970-79 b) Expenditure by government agencies on air pollution measurement equipment of \$20 $\overline{M}$ in 1972
Wall Street Transcript	1 December 1969	Auto pollution measurement equipment sales in N. America of \$4 $\overline{M}$ in 1969 and \$10 $\overline{M}$ in 1970
Chemical & Engineering News	19 August 1968, p. 20	1969 expenditure for air and solid waste control instruments of \$8 $\overline{M}$ by industry and \$16 $\overline{M}$ by government

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* Instrument market reported as part of the Electronic Industry Survey.

4. AMBIENT AIR QUALITY LEVEL MEASUREMENTS

Ambient air quality is the quality of the air that we all breathe. The air quality level is the result of the emission of pollutants from a wide variety of discrete stationary and mobile sources of emissions, superimposed upon a background level which includes major emissions of some of these same pollutants from natural sources. Wide variations in the ambient air quality level exist in different regions of the Nation as a result of differing local concentrations of discrete sources and the presence of geographical formations and climatological conditions which enhance or hinder the dispersive forces of the atmosphere. This section of the report is concerned with the type and quantity of instrumentation which will be required to measure the ambient air quality level throughout the United States.

Characteristics of the Market

The market for instrumentation to measure the ambient air quality level is an existing market. For some specific air pollution agents, such as SO_2, a portion of the initial purchase market has already been met, but by far the major purchases in this market seqment will be made during the next few years. In arriving at the market estimate four parameters have been analyzed:

(1) Legal basis for measurement requirements
(2) Users of instrumentation
(3) Pollutants requiring measurement
(4) Instrumentation requirements

Legal Basis for Measurement Requirements: The Clean Air Amendments of 1970*, like previous federal legislation, requires the states to implement plans to achieve established air quality standards. In some urban regions of the Nation, existing air pollutant levels are still above the desired air quality standards and it is necessary to monitor the ambient air quality level to determine the progress of the implementation plan in achieving clean air and to measure trends in air quality.

The 1970 Amendments provide federal funds to match air pollution control agency expenditures for establishing, improving and maintaining programs for implementation of national air quality standards (11a). The state implementation plan must include provisions for establishment and operation of appropriate devices necessary to monitor data on ambient air quality (11b). The author interprets these sections of the amendments as encouraging and financially supporting ambient level measurements.

Historically, the federal government and the states have long been active in air quality measurement--the federal program having been initiated in 1953 as the National Air Sampling Network (NASN) and state programs having been initiated prior to 1961 in California, Maryland, Massachusetts, Texas, New York and Washington.

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* The "Clean Air Amendments of 1970"--P.L. 91-604 (December 1970) will be referred to hereafter as the 1970 Amendments.

The establishment of state implementation plans, first required by the Air Quality Act of 1967, has provided emergency measures to protect the health and welfare of the populace during periods of acute air pollution caused by adverse climatological factors--the so-called air pollution episodes. Such emergency measures have required a real-time measurement capability to enable swift and effective measures to reduce air pollution when levels dangerous to health occur.

Users of Instrumentation: Ambient air quality measurement is predominantly a government responsibility, shared between the federal, state and local levels. Industry has offered some market for ambient air quality measurement during the latter half of the 1960's, partly because of regulations by local air pollution control agencies that required a specified number of ambient monitors around a new plant site. The trend in new legislation appears to be toward stricter enforcement and measurement of industrial emission at the industrial sources and this, in the author's opinion, should preclude any sizeable investment by industry in ambient air quality measurement instruments. The industrial market for ambient air quality level measurement instrumentation has been assumed negligible for the remainder of the decade.*

Pollutants Requiring Measurement: The reason for controls on the emission of pollution agents from various discrete sources, whether they be stationary or mobile, is to achieve an acceptable level of air quality for a particular air pollutant. One can, therefore, expect that it will be necessary to measure the ambient air quality level for all air pollution agents or combinations of agents which have been identified as injurious to health and welfare. The air pollution agents identified at this time include

Class I:
- Particulates (Total mass and fine particulate)
- Sulfur oxides (SO_2, SO_3 and H_2SO_4 mist)
- Non-Methane Hydrocarbon
- Carbon monoxide
- Oxidants (including ozone)
- Oxides of nitrogen (NO_2, NO)
- Lead
- Odors (including sulfurous odors, amines, and organic acids)
- Polynuclear organic matter
- Fluorides

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* Contrary views on the industrial market for ambient air quality level measurement instrumentation have been put forth. These views reflect a sharp increase in industry's utilization of ambient air monitors to assess the plant's contribution to the air quality of the community. If these views are borne out the quantity of ambient air quality monitors required during the decade could be twice that estimated in this report. The reader is referred to the article on Pollution Measurement Instrumentation in the February 15, 1971 issue of Chemical and Engineering News for one discussion of these differences.

Class II: Arsenic
Chlorine gas
Hydrogen chloride
Copper
Manganese
Nickel
Vanadium
Zinc
Barium
Boron
Chromium
Selenium
Pesticides
Radioactive substances
Asbestos
Beryllium
Cadmium
Mercury

The listing of pollution agents has been divided into two classes only as a matter of convenience for subsequent analysis of the instrumentation market. The pollution agents in Class I include those agents whose presence in the ambient air is widespread through the United States. These agents are accordingly expected to be widely measured through the federal, state and local monitoring networks.

The pollution agents in Class II, while of concern to health and welfare--in fact the last four named agents are regarded as hazardous materials--normally are associated with local deteriorations of air quality and will be monitored on a limited basis. An estimate of the market for instrumentation to measure the Class II pollution agents has not been made for this analysis.

Instrumentation Requirements: The measurement of ambient air quality levels will require two distinct types of measuring instrumentation. Continuous measuring instrumentation will be required to provide real-time information on the concentration level of specific pollution agents so that control agencies can implement their emergency action plans when the air quality level approaches a predetermined level judged particularly dangerous to health.

Continuous air monitoring instrumentation for this application has been identified with providing real-time information, both these designations having been responsible for past misconceptions of the needs in this area of measurement. Real-time information in this connotation refers to information that is available sufficiently fast to provide timely guidance for action by control agencies. For all pollution agents, information is most likely not needed in less than five minutes; for nitrogen oxides, oxidants, hydrocarbons and carbon monoxides, it should probably not lag behind the actual air quality level by more than 10 or 15 minutes. In this connotation, continuous air monitoring refers to periodic repetitions of the measurement at intervals not to exceed the time period in which the information provided by the measurement can be utilized.

Measurements will also be required to provide information to determine the trend in ambient air quality level for each pollutant. This type of instrumentation will supplement the continuous air monitoring instruments and will enable air quality levels to be economically monitored, even in those areas currently at or within acceptable standard levels. This type of instrumentation will often operate at extremely low levels of ambient air pollutants and will attain the required sensitivity by integrating the sample over a period of time. The integrated sample will periodically be returned to a laboratory for analysis as is currently done with gaseous bubber collection systems and the Hi-Vol suspended particulate collectors.

The development of new and improved instruments that can follow the trend in pollution concentration could radically change the future method of trend measurements. It may be possible to obtain instruments that can be read in the field and reset for operation during a subsequent time period. It is not expected that development of a continuous monitoring instrument with the requisite sensitivity to be capable of measurement at trend levels would be a major factor in this market as the need for continuous information in regions where trend measurement will be widely applied is not apparent.

Method Used to Estimate the Market

This section of the report describes the method used to estimate the market for ambient air quality level measurement instrumentation. The estimates for continuous air monitoring instruments and for the trend indicating instruments will be described separately.

Continuous Air Monitoring Instruments (CAM)

The market for continuous air monitoring stations was estimated by considering parameters which might be involved in determining the number of stations required to adequately measure the air quality level in a given control region--a station is a complex containing one or more instruments and associated hardware. Parameters investigated included: population of the region; value added by manufacturing as a measure of industrial activity; area of the region; population density; number of cities in the region with population exceeding a given level; number of cities in the region with value added by manufacturing exceeding a given level; and expenditures by local governments for hospital and health as an indication of concern for public health.

Historical data and future plans(13-20) for state and local air pollution control agencies in the Middle Atlantic States and in California were analyzed. Little correlation was found between the number of continuous air monitoring stations and those factors related to geographical area, population density, or industrial concentration. As the geographical size of the regions increased, a correlation with total population was evident.

TABLE 7

CONTINUOUS AIR MONITORING STATION REQUIREMENTS(1)

Region	State	Local*	Total	Population M (1960)	Stations per M Population
N.Y. (State)	50	10	60	16.8	3.6
N.J. (State)	22	--	22	6.0	3.7
Pa. (State)	25	17	42	11.3	3.7
Cal. (State)	15	35	50	15.9	3.1

---

* Local category includes monitoring stations operated under the directions of municipal governments.

(1) Continuous air quality measurement instrumentation requirements for these regions has been based partly on references 13 to 20.

For the purposes of this analysis a state and local governmental control agency requirement of 3.7 CAM stations per million population has been used for a total of 750 installed stations during the decade. The federal network which will supplement this network has been estimated at 175 stations$^{(5a)}$.

Continuous air monitoring stations have the responsibility for monitoring ambient air quality levels and it has been assumed that each station would have instrumentation to measure the nine widespread pollutants: particulates, sulfur oxides, hydrocarbons, oxidants, carbon monoxide, oxides of nitrogen, polynuclear organic matter, lead and odors. Odor instrumentation is expected to consist of instruments sensitive to a particular chemical species characteristic of local odor problems, e.g., mercaptans, hydrogen sulfide, amines, or acrolein. Oxides of nitrogen measurement will likely continue to require two distinct measurements, one for nitrogen dioxide (NO_2) and the other for nitric oxide (NO). The probability of each station in the state and local governmental networks installing instrumentation to measure each pollutant is assumed to be unity for the first six named pollutants and somewhat lower for the remaining three. The federal government operated CAM stations are assumed to measure all named pollutants.

Trend Indication Instrumentation

Trend indication instrumentation has been referred to in the past by various names: manual monitoring, mechanized non-automatic devices and simple instrumentation. All of these designations are adequate to describe certain devices which are normally included in trend indicator networks although a particular device may not be adequately described by a single designation. For the purpose of this analysis trend indicator instruments are intermittently operated collection devices which require separate laboratory facilities for analysis of the sample.

A trend indicator air quality monitoring station can be expected to consist of static and mechanized collection devices. Static devices will include sulfation rate collectors for sulfur dioxide and dustfall buckets to measure settleable particulate. The mechanized collection devices will include bubblers or equivalent collectors for the gaseous pollutants covered by national air quality standards and hi-vol samplers for the determination of suspended particulates.

The number of trend indication instrumentation installations is based on "published" estimates by the National Air Pollution Control Administration (now EPA) of the number of sampling stations required in order to provide a reasonable definition of the air quality over urban areas, as well as background pollutant levels in less-affected portions of the country. EPA has estimated a need for 10,000 sampling stations, of which 8,000 would be employed in the 231 standard metropolitan statistical areas (1a,5a). The federal network would account for approximately 1,000 stations. Assuming that nearly 10% of the total station requirement will be met by continuous air monitoring stations, the required number of trend indicator stations has been placed at 9,000 units, of which nearly 1,000 would be used in the federal network.

Replacement Market

The estimated replacement market for ambient air quality level monitoring instrumentation has been based on an expected life for this type of instrumentation. It has been assumed that continuous air quality level monitors will be replaced between years 5 and 10 following their purchase, i.e., an effective life cycle of 7 or 8 years for the instruments. Lacking additional information we have further assumed a cumulative replacement between years 5 and 10, as shown in Table 8. Replacement market has been estimated by applying this cumulative replacement rate to the initial instrument purchases.

TABLE 8

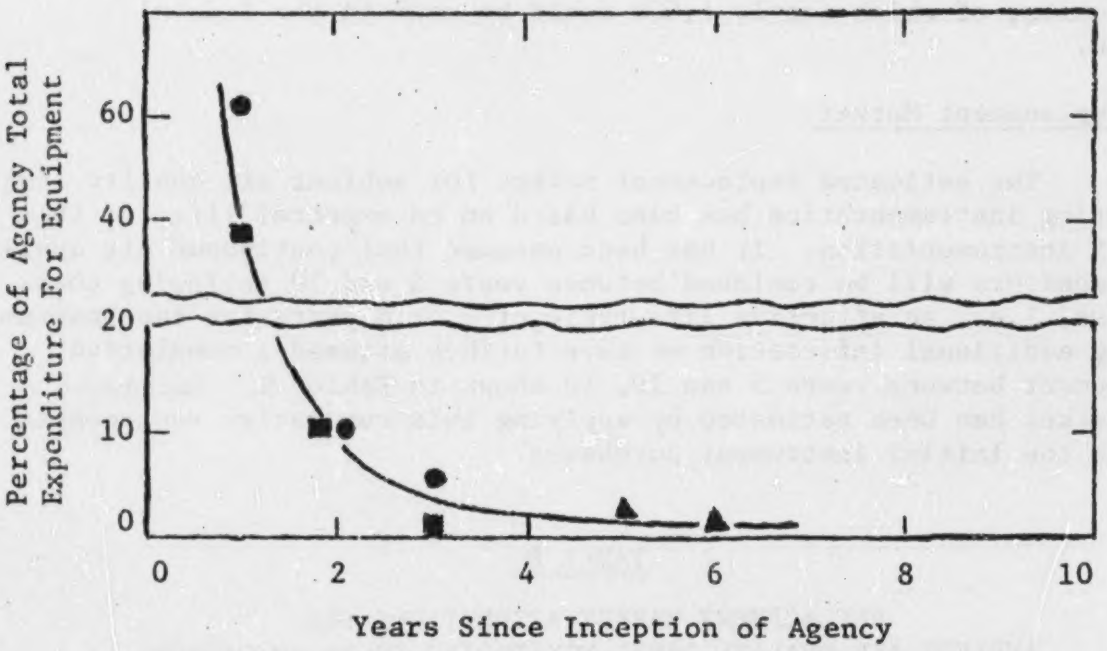
REPLACEMENT MARKET ASSUMPTIONS FOR AMBIENT AIR QUALITY LEVEL MONITORING INSTRUMENTATION

Year Since Installation of Instrument	Cumulative Replacement %
5	0
6	30
7	50
8	60
9	70
10	90

The cost of this replacement program has been compared with historical trends which indicate that as an agency matures the percentage of its total operating budget which is spent on total equipment is perhaps no more than 3% Information to support this value is given in Figure 2, which is based on a limited sample of information obtained from the records of the Control Agency Development Division, National Air Pollution Control Administration (now EPA). Based on an estimated expenditure no greater than 3% of total budget for instrumentation and assuming that very shortly into the decade we will achieve an expenditure for air pollution control of 50¢ per capita by control agencies, we estimate that agency funding available for replacement and upgrading of ambient level measurement instrumentation will amount to an average of about $3 M a year in the period of 1974-1980.

FIGURE 2

EXPENDITURES BY CONTROL AGENCIES ON EQUIPMENT*



Market Estimates

This section of the report presents the estimated market for ambient air quality level monitoring instrumentation during the period 1971-1980. Tables 9 to 13 present the basis and the estimate for the continuous air quality monitor market and Tables 14 and 15 present similar data for trend indication instrumentation.

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*Data for this graph supplied by the Control Agency Development Division, National Air Pollution Control Administration (now EPA).

TABLE 9

CONTINUOUS AIR MONITORING STATIONS

Estimate of Number of Stations Required

State & Local Station Requirement

Basis: 3.7 stations per 1 million population (1960) (a)

U.S. population (1970) 206 million (b)

Estimate of total no. of stations required:

3.7 x 206 = 762

Federal Station Requirement

Basis: 150-200 Stations (c)

Total Station Requirement Estimate Used for this Analysis

State & Local Stations - 775

Federal Stations - 175

950

Sources: (a) This study - Table 7

(b) Survey of Current Business, U.S. Dept. Commerce, August 1970.

(c) Reference 1 a

TABLE 10

CONTINUOUS AIR MONITORING STATIONS

Instrumentation Currently Installed (Estimates for June 1970) (a)

Analyzer	State & Local Agencies	Federal	Total
Sulfur Dioxide	235	44	279
Nitric Oxide	117	17	134
Nitrogen Dioxide	189	17	206
Carbon Monoxide	218	10	228
Non-Methane Hydrocarbon	--	--	(Z)
Oxidants	122	14	136
Polynuclear Organic Matter	--	--	(Z)
Odors (b)	83	--	83
Automatic Tape Soiling Index	367	7	374
Particulate Total Mass	--	--	(Z)
Fluorides	--	--	(Z)

(a) Source: Reference 2, p. 6.

(b) Odor instruments listed above include only H_2S analyzers.

(Z) Less than 25 instruments are estimated to be in use.

TABLE 11

CONTINUOUS AIR MONITORING STATIONS

Replacement Market for Continuous Air Monitoring Instrumentation

Analyzer	Estimated Date of Installation of 95% of Initial Purchases	Estimated Replacement Market 1971-80 (% of Initial Purchases)
Sulfur Dioxide	1974	70
Nitric Oxide	1974	60
Nitrogen Dioxide	1974	60
Carbon Monoxide	1974	60
Non-Methane Hydrocarbon	1974	60
Oxidants (ozone)	1974	60
Polynuclear Organic Matter	1974	30
Odors	1975-6	40
Automatic Tape Soiling Index	1974	*
Particulate Total Mass	1978	0
Fluorides	1977	0

* Assumes automatic tape soiling index analyzers will be replaced by particulate total mass analyzers.

TABLE 12

CONTINUOUS AIR MONITORING STATIONS

Typical Station Instrumentation Requirement

Analyzer	No. of Instruments per Station	Assumed Parameters for Market Analyzers: Probability of Station Having Analysis	Assumed Parameters for Market Analyzers: Instrument Cost* (per Unit)
Sulfur Dioxide (SO_2)	1	1	4000
Nitric Oxide (NO)	1	0.8	4000
Nitrogen Dioxide (NO_2)	1	1	4000
Carbon Monoxide (CO)	1	1	4000
Non-Methane Hydrocarbon	1	1	4000
Oxidants (a)	1	1	4000
Polynuclear Organic Matter	1	0.4	4000
Odors (b)	2	0.5	4000
Automatic Tape Soiling Index	1	0.8	750
Particulate Total Mass (c)	1	0.6	3000
Fluorides	1	0.4	4000

(a) Ozone measuring instruments are assumed to replace oxidant analyzers during market study period.

(b) Odor instruments will measure specific chemical species common to local odor emissions.

(c) Instrumentation to determine total mass of particulate in ambient air are assumed to replace automatic tape soiling index analyzers during market study period.

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* The reader is referred to Section 7, beginning on page 82 , for a discussion of probable instrumentation cost.

TABLE 13

CONTINUOUS AIR MONITORING STATIONS

Estimate of Instrumentation Purchases 1971-80

Analyzer	Instruments Required (a)	Instruments Currently Installed (b)	Initial Purchases	Replacements Market (c)	Total Purchases
Sulfur Dioxide	950	279	671	750	1421
Nitric Oxide	760	134	626	510	1136
Nitrogen Dioxide	950	206	744	650	1394
Carbon Monoxide	950	228	722	660	1382
Non-Methane Hydrocarbon	950	--	950	570	1520
Oxidants (ozone)	950	136	814	620	1434
Polynuclear Organic Matter	380	--	380	110	490
Odors	950	83	867	425	1292
Automatic Tape Soiling Index	760	374	386	--	386
Particulate Total Mass	570	--	570	--	570
Fluorides	380	--	380	--	380

(a) Source: This study - Table 9.

(b) Source: This study - Table 10

(c) Replacement market assumes complete replacement of currently installed instruments and fractional replacement of initial purchases.

TABLE 14
TREND INDICATION INSTRUMENTATION

Total Station Requirement Estimate(a):

Federal stations - 1000
State and Local stations - 8000

Probable Station Instrument Components:

Collection Device	No. per Station	Probability of Station Having Device	Assumed Cost * For Market Analysis (per unit)
Gas Collection Devices (b)	2	1	$500
Dust Fall Collector for Settleable Particulates	1	1	50
High Volume Sampler for Suspended Particulates	1	1	500

(a) Source: Reference 1 - p. 75.
(b) Assumes a device for collecting (and analyzing) 24 hour samples will be required for two gaseous pollutants, probably SO_2 and NO_2.

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*The reader is referred to Section 7, beginning on page 82, for a discussion of probable instrumentation costs.

TABLE 15
TREND INDICATION INSTRUMENTATION

Collection Devices Currently Installed:

Collection Device	No. of Devices Installed As of June 1969(a)		
	Federal	State & Local	Total
Gas Collection Devices (c)	435	727	1162
Dustfall Collector	270	2017	2287
High-Volume Sampler	293	1474	1767

Market Estimate: 1970-80 (Units)

Collection Device	Devices Required	Currently Installed	Initial Purchases	Replacements(b)	Total Market
Gas Collection Devices	18,000	1162	16,838	9578	26,416
Dustfall Collector	9,000	2287	6,713	5643	12,356
High-Volume Sampler	9,000	1767	7,233	5383	12,616

(a) Source: Reference 2, p. 6.

(b) Replacements based on complete replacement of currently installed devices and 50% replacement of new purchases.

(c) Gas collection devices currently installed to obtain 24 hour samples of SO_2, NO_2, and oxidants.

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5. STATIONARY SOURCE EMISSION MEASUREMENTS

Stationary sources of air pollution consist of discrete sources of air pollution that are recognized as significant contributors to the deterioration of local and regional air quality. This section of the report is concerned with the type and quantity of instrumentation which will be required to measure the emissions from these sources at the point of emission.

Characteristics of the Market

The market for stationary source emission measurement instrumentation is an emerging market, i.e., the need for such instrumentation is only beginning to be appreciated. This emergent nature of the market makes the prediction of the market size during the decade of the 1970's a difficult and uncertain undertaking. The market estimated in this report has required a fair number of assumptions which will be discussed in the following sections. In arriving at the market estimate, four parameters have been analyzed:

(1) Legal basis for measurement requirements
(2) Industries potentially affected
(3) User of instrumentation
(4) Pollutants requiring measurement

Legal Basis for Measurement Requirements: The 1970 Amendments speed up the air quality standard setting procedure by requiring the designation of National Ambient Air Quality Standards by the Federal government. The states have the responsibility for establishing the implementation plans to meet these standards. The 1970 Amendments require that the state implementation plan provide requirements for installation of equipment by owners of stationary sources to monitor emissions from such sources and for periodic reports on the nature and amounts of such emissions(11c). This provision of the 1970 Amendments suggests an increasing market for instrumentation to be used by the owner or operator of the stationary source to monitor his own emissions.

The 1970 Amendments also provides for New Source Performance Standards. The new source performance standards are designed to insure that new stationary sources are operated so as to reduce emissions to the minimum (11f). The performance standards would be applied to new sources of air pollution in specific industries (the industries affected will be discussed in a later section). The pollutants considered in this analysis are those expected to be covered by the National Ambient Air Quality Standards. The Administrator of the Environmental Protection Agency may for the purpose of implementing the standards of performance for new stationary sources or to enable him to determine whether such source is in compliance with the new source performance standards require the owner or operator of any emission source to install, use and maintain monitoring equipment or methods and sample such emissions at such intervals, and in such a manner as the Administrator shall prescribe (11d).

The 1970 Amendments also establishes emission standards for hazardous agents. These hazardous agents are expected to include asbestos, beryllium, cadmium and mercury (6c). This analysis does not consider the potential market for instrumentation that may be used for measurement of these hazardous agents (11g).

The 1970 Amendments also provide for a procedure under which the States shall submit a plan which establishes standards for existing sources for those air pollutants for which air quality criteria have not been issued or which is not included under national air quality standards or hazardous pollutants but to which a standard of performance would apply if such existing source were a new source (11e).

Users of Instrumentation: The users of stationary source measurement instrumentation consist of two major groups: control agencies and pollutant emitters. The control agencies require stationary source measurement instruments to carry out their responsibility to periodically monitor stationary sources to determine if emissions comply with the established emission standards. Instrumentation for the application should be portable and be able to be rapidly installed at the source.

The owners or operators of emission sources will require instruments to fulfill their responsibility to install and use monitoring equipment as required by state implementation plans. It is expected that this monitoring requirement will be extended to include both eixsting sources (11d) in industries covered by new source performance standards and new sources covered by the Federal new source performance standards (11e). State requirements for industry to install such monitoring instrumentation will reduce the need for extensive monitoring of source emissions by control agency inspectors, monitoring which would otherwise by required to insure that source emissions were being maintained at standard levels. Instrumentation for this monitoring will not be required in all cases; in some instances, periodic sampling of the effluent, followed by laboratory analysis of the sample, will suffice for obtaining a record of emissions. It is expected, however, that industry will more than be able to justify the cost of continuous monitoring instruments by savings in sampling and laboratory analysis time. Continuous monitoring instrumentation will also double as a means of providing information to adjust and control the emission control technology that will be installed to reduce emissions.

Industries Potentially Affected: Industry sources expected to be subject to the provisions of the new sources performance standards in the 1970 Amendment include:*

- Cement manufacturing
- Coal cleaning operations
- Coke byproduct manufacturing
- Cotton ginning
- Ferro alloy plants
- Grain milling and handling operations
- Gray Iron foundries
- Iron and steel operations
- Nitric acid manufacturing
- Nonferrous metallurgical operations (e.g., aluminum reduction, copper, lead and zinc smelting)
- Petroleum refining
- Phosphate fertilizer manufacturing
- Phosphoric acid manufacturing
- Pulp and paper operations
- Rendering plants (animal matter)
- Sulfuric acid manufacturing
- Soap and detergent manufacturing
- Municipal incinerators
- Steam electric power plants
- Lime manufacturing operations
- Petroleum storage facilities
- Asphalt batching plants
- Other chemical plants
- Carbon black manufacturing
- Industrial boilers
- Commercial-institutional heating plants
- Residential heating plants
- Other incinerators

Several additional industry sources which were not included in this market analysis are also being considered for new source performance standards. These include:

- Animal feed defluorination plants
- Chlorine and caustic plants
- Brass and bronze refining
- Phosphorus reduction plants
- Petrochemical plants
- Paint and varnish plants
- Graphic arts industry

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* Some of these industry sources have been suggested for new source performance standards by the administration (6d), while additional sources have been assumed for this analysis.

Pollutants Requiring Measurement: The pollutants that may require measurement fall into three groups. The first group includes those pollutants for which national ambient Air Quality standards have been issued or that the author assumes will be issued during the decade. For these pollutants, the states will establish as part of their implementation plan emission limitations on source emissions for all existing facilities and the federal government will specify emission limitations for new sources as part of the new source performance standards for selected industries. For this analysis these pollutants are assumed to be:

Total suspended particulates
Sulfur dioxide
Non-CH_4 hydrocarbons
Carbon monoxide
Polynuclear organic matter
Fluorides
Lead
Odors
Nitrogen dioxide

Nitric oxide although not covered under national ambient air quality standards will be considered under this group for analysis of the market for stationary source emission measurement instrumentation. Nitric oxide is the prevalent form of the oxides of nitrogen from many stationary sources and after leaving the stack is oxidized further to nitrogen dioxide which is measured in the ambient atmosphere.

The second group of pollutants are those pollutants being considered for coverage by hazardous agent emission standards. These include:

Asbestos
Mercury
Beryllium
Cadmium

The third group of pollutants includes those air pollutants not presently covered or expected to be covered by national ambient air quality standards or defined as hazardous agents but which could be designated for new source performance standards or as hazardous agents. These include:

Arsenic
Chrlorine gas
Hydrogen chloride
Copper
Manganese
Nickel
Vanadium
Zinc

Barium
Boron
Chromium
Selenium
Pesticides
Radioactive substances

Method Used to Estimate the Market

In estimating the market for stationary source emission measurement instrumentation, the lack of historical data on which to base an extrapolation of future trends has necessitated many assumptions concerning future measurement application. This section of the report discusses the assumptions that have been made in arriving at the market estimate for stationary source emission measurements.

Industry Requirements: The assumptions required in estimating the market for stationary source emission measurement do not involve what pollutants are to be measured or which emitters potentially will be required to make measurements but involves rather what degree of measurement will be required. In this analysis, measurement is assumed to be required only after emission control mechanisms are installed. This assumption is based upon the premise that the prime value of the measurement instrumentation will be to obtain information either to assist in the operation of the control equipment and/or to determine if the control equipment is performing in a manner to enable the emission standards to be met.

The procedure followed in making the assessment of the stationary source emission market began with the assembly of an inventory of stationary sources and industry growth rate information. This inventory has been based primarily on previously issued federal government documents, particularly "The Cost of Clean Air, 2nd Report" (8) and the "National Emissions Standards Study" (9). Additional information has been obtained from the "Inventory Data on Specific Types of Emission Sources" prepared for Esso Research and Engineering Company by the management consultant firm of Stevenson, Jordan and Harrison. The inventory of stationary sources is presented in Table 16 and includes, when information has been available, a listing of the individual units at a given source. In many cases only information on the number of plant sites is available and our use of plant sites, in these instances, rather than operating units is expected to result in an underevaluation of the total market for stationary source measurement instrumentation.

Several potential air pollutant emission sources have not been includes in the listing of sources, notably electric arc furnaces, induction furnaces, crucibles and reverberatory furnaces located in the foundry industry. These sources and others which may be considered by EPA for emission control by means of the New Source Performance Standards represent a potential additional market for instrumentation which is not included in this report.

The source inventory and industry growth rate data were then used to prepare Table 17, an estimate of both the present number of sources and the additional new sources expected during the decade. New sources, in this connotation, represent a generic class of facilities that can lead to an increase in the total number of point sources of pollution and includes new plants as well as major capacity increases at current plants. The number of new facilities has been estimated using published estimates of the anticipated industry growth during the seventies. This published information is available as projected industry capacity increases and requires a judgement as to future plant size to arrive at the desired number of new pollution sources. While no specific industry information was available for this analysis regarding future plant size trends, the assumption was made that plant sizes would increase, resulting in fewer new sources at which measurements would be required.

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TABLE 16

INVENTORY OF STATIONARY SOURCES AND INDUSTRY GROWTH RATES

	Historical Data			Industry Growth-Rate (i) 1970-80 %
	No. of Sources	Year	Reference	
Utility Power Generating Units(d)	1,751	1968	c	80
Cement Kilns	180	1968	b	50
Petroleum Refineries(g)	224	1968	b	30
Kraft-Pulp Mills	113	1968	b	80
Non-Ferrous Smelters				
Copper	24	1968	b	30
Lead and Zinc	19	1967	b	15
Iron-Steel Industry				
Gray Iron (Cupolas)	1,929	1968	c	45
Steel(e)	909	1968	c	45
Pig-Iron(f)	225	1968	c	45
Carbon Black	30	1968	b	35
Coal Cleaning	667	1967	b	100
Coke (By-Product)	65	1967	b	20
Cotton-Ginning	4,448	1968	b	N.A.
Ferro-Alloy	51	1967	b	20
Grain Milling				
Flour Mills	618	1963	b	15
Elevators	11,147	1968	b	15
Nitric Acid	72	1968	b	100
Phosphate Fertilizers				
Manufacture	259	1968	b	65
Granulation	350	1967	b	65
Phosphoric Acid	73	1967	b	65
Rendering	920	1968	b	N.A.
Soap and Detergent	1,069	1968	b	0
Sulfuric Acid	213	1967	b	45
Lime	135	1967	a	

TABLE 16 CONTINUED

INVENTORY OF STATIONARY SOURCES AND INDUSTRY GROWTH RATES

	Historical Data			Industry Growth-Rate(b) 1970-80 %
	No. of Sources	Year	Reference	
(Continued)				
Asphalt Batching	1,500	1967	a	
Aluminum	24	1968	b	90
Secondary Non-Ferrous				
Copper	20	1967	b	
Lead and Zinc	76	1967	b	
Petroleum Storage	29,664	1968	a	
Group III				
Industrial Boilers	307,000	1967	a	
Commercial-Institutional Heating Plants	999,000	1967	a	
Residential Heating Plants	58,000,000	1967	a	
Municipal Incinerators	465	1967	c	
Other Incinerators(h)	13,300	1968	c	

(N.A.) - Information not available.

(a) "The Cost of Clean Air" 2nd Rept. of the Secretary DHEW, Senate Doct. 91-65, April 27, 1970.

(b) "National Emissions Standards Study," Senate Doct. 91-63, April 27, 1970.

(c) Stevenson, Jordan and Harrison. "Inventory Data on Specific Types of Emission Sources," March 1969.

(d) Coal and/or oil steam generating units, 294 of which have a generating capacity of 200 MW or greater.

(e) Includes 62 Basic Oxygen Furnaces and 544 open hearths and 303 electric arc furnaces.

(f) Totals include blast furnaces only.

(g) These petroleum refining sources include 118 catalytic crackers.

(h) Includes incinerators in schools containing over 1400 pupils and in apartment houses containing over 100 dwelling units.

(i) The industry growth rate is given as a percentage increase in the production capacity and is taken from the "National Emissions Standards Study," Senate Doct. 91-63, April 27, 1970, page 82, unless otherwise noted.

TABLE 17

ESTIMATES OF THE NUMBER OF STATIONARY SOURCES

	Estimated Present Sources 1970	Estimated New Sources 1970-80
Steam-Electric Power Plants	1750	180(a)
Cement Plants	300	60
Petroleum Refineries	220	40
Kraft-Pulp Mills	120	60
Non-Ferrous Smelters	41	10
Copper		
Lead and Zinc		
Iron-Steel		
Gray Iron (Cupolas)	1800	400
Steel	900	200
Pig-Iron (Blast Furnaces)	225	75
Carbon Black	32	5
Coal Cleaning	700	400
Coke (By-Product)	68	10
Cotton-Ginning	4000	0
Ferro-Alloy	54	10
Grain Milling		
Flour Mills	700	90
Elevators	11500	(b)
Nitric Acid	80	50
Phosphate Fertilizers		
Manufacture	235	120
Granulation	350	200
Phosphoric Acid	75	40
Rendering Plants	900	(b)
Soap and Detergent	1050	(b)
Sulfuric Acid	213	80
Lime	135	50
Asphalt Batching	1500	
Aluminum	25	20
Secondary Non-Ferrous		
Copper	20	(b)
Lead and Zinc	75	(b)
Petroleum Storage	30000	(b)
Industrial Boilers	300000	(b)
Commercial-Institutional Heating Plants	1000000	(b)
Residential Plants	60000000	(b)
Municipal Incinerators	495	450
Other Incinerators(c)	14000	(b)

(a) Estimated from 138 gigawatt increase in fossil fueled steam electric power generating capacity during the decade and an average generating unit size of 750 MW. Data from Tables 38 and 46 from reference No. 10.

(b) No estimate has been made for the number of new sources.

(c) See note (h) on Table 16.

The next step in the assessment of the stationary source measurement instrumentation market required a determination of which industries were likely to have to measure their emissions. As the policy regarding measurements at the source of emissions has yet to be formulated, we were required to make a judgement of those industries which are likely candidates for stationary source measurement instrumentation.

In making these judgements we have assembled data on the emissions of selected pollutants for the industries previously listed and on the number of specific source locations in each industry. We then calculated for each source and pollutant the percentage of the total U.S. stationary source emission of a given pollutant that is due to the industry as a whole and the average emission of the pollutant per source. The information on industry emissions was obtained from the "National Emission Standards Study"(9) and "The Cost of Clean Air, 2nd Report"(8). Much of the information on industry emissions is not yet available and has resulted in many blank entries in Table 17. Once detailed information on industry emissions is available from current and planned EPA studies, additional industries may be candidates for routine monitoring of stationary source emissions.

The method used provides an indicator of both the national and local air quality deterioration which would be associated with uncontrolled emissions. From the value of these parameters potential candidate industries for routine emission monitoring were selected. Any source-pollutant combinations that represented a high local emission rate or high national total emissions were judged candidates for routine measurement. This resulted in selecting as candidates for measurement instrumentation only a relatively small fraction of the sources and pollutant combinations that are likely to be controlled. Tables 18-A through 18-E present a tabulation of industry emissions, average emissions per source, and our estimate of the candidates for measurement for the six pollutants considered in the stationary source measurement instrumentation market analysis.

TABLE 18-A

INVENTORY OF EMISSIONS(a)

PARTICULATES	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission As % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	Candidate for Measurement Instruments for Continuous Monitoring
Steam-Electric Power Plants	5530	26.7	17.0(b)	Yes
Cement Plants	870	4.2	4.9	Yes
Petroleum Refineries	85	0.4	0.4	Yes
Kraft-Pulp Mills	630	3.0	5.6	Yes
Non-Ferrous Smelters				
Copper	60	0.3	2.5	Yes
Lead and Zinc	84	0.4	4.4	Yes
Iron-Steel				
Gray Iron Foundries	190	0.9	0.1	Yes
Steel	1700	8.2	12.3(c)	Yes
Pig-Iron				Yes
Carbon Black	103	0.5	3.4	Yes
Coal Cleaning	160	0.8	0.2	No
Coke (By-Product)	94	0.4	1.4	Yes
Cotton-Ginning	30	0.1	0.01	No
Ferro-Alloy	275	1.3	5.4	Yes
Grain Milling	1122	5.4	0.1	Part
Flour Mills				
Elevators				
Nitric Acid	50	0.2	0.7	Yes
Phosphate Fertilizers	259	1.2	0.7	Yes
Manufacture				Yes
Granulation				Yes
Phosphoric Acid	5	--	0.1	No
Rendering				
Soap and Detergent				
Sulfuric Acid	60	0.3	0.1	Yes
Lime	450	2.1	3.3	Yes

TABLE 18-A Continued

INVENTORY OF EMISSIONS(a)

PARTICULATES	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	Candidate for Measurement Instruments for Continuous Monitoring
Asphalt Batching	522	2.5	0.3	Part
Aluminum	92	0.4	3.8	Yes
Secondary Non-Ferrous	48	0.2	0.5	Yes
Copper				
Lead and Zinc				
Petroleum Storage				
Organic Chemicals				
Industrial Boilers	3000	14.4		Part
Commercial-Institutional Heating Plants	105	0.5		Part
Residential Heating Plants	314	1.5		No
Municipal Incinerators	136	0.7	0.3	Yes
Other Incinerators	--	--	--	Part

(a) Emission data obtained from reference 8, Tables 3.2 and 3.8, and reference 9, Table 2.1.
(b) Based on 325 plants of 100 MW or greater generating capacity. Reference 9, Table 2.2.
(c) Based on 138 plants, reference 9, Table 2.2.

TABLE 18-B

INVENTORY OF EMISSIONS(a)

SULFUR DIOXIDE	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	Candidate for Measurements Instruments for Continuous Monitoring
Steam-Electric Power Plants (b)	15,000	49.	46.0	Part (c)
Cement Plants				
Petroleum Refineries	2,100	6.8	9.4	Yes
Kraft-Pulp Mills	84	0.3	0.7	Yes
Non-Ferrous Smelters				
Copper	2,950	9.6	155.	Yes
Lead and Zinc	903	2.9	43.	Yes
Iron-Steel				
Gray Iron Foundries				
Steel				
Pig-Iron				
Carbon Black				
Coal Cleaning				
Coke (By-Product)	600	1.9	9.2	Yes
Cotton-Ginning				
Ferro-Alloy				
Grain Milling				
Flour Mills				
Elevators				
Nitric Acid				
Phosphate Fertilizers				
Manufacture				
Granulation				
Phosphoric Acid				
Rendering				
Soap and Detergent				
Sulfuric Acid	590	1.9	2.8	Yes
Lime				

TABLE 18-B Continued
INVENTORY OF EMISSIONS(a)

SULFUR DIOXIDE	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	Candidate for Measurements Instruments for Continuous Monitoring
(Continued)				
Asphalt Batching				
Aluminum	54	0.2	2.2	Yes
Secondary Non-Ferrous				
Copper				
Lead and Zinc				
Petroleum Storage				
Industrial Boilers				Part
Commercial-Institutional Heating Plants				Part
Residential Plants				No
Municipal Incinerators				No
Other Incinerators				No

(a) Emission data obtained from reference 8, Tables 3.2 and 3.8, and reference 9, Table 2.1.
(b) Based on 325 plants of 100 MW or greater generating capacity. Reference 9, Table 2.2.
(c) Assumes a substantial number of electric power plants will switch to low sulfur content fuels.

TABLE 18-C

INVENTORY OF EMISSIONS(a)

CARBON MONOXIDE	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	Candidate for Measurements Instruments for Continuous Monitoring
Steam-Electric Power Plants				
Cement Plants				
Petroleum Refineries	2030	6.8	9.1	Yes
Kraft-Pulp Mills	2600	8.7	23.0	Yes
Non-Ferrous Smelters				
Copper				
Lead and Zinc				
Iron-Steel				
Gray Iron Foundries	3500	11.7	2.1	Yes
Steel }	75	0.3	0.5	No
Pig-Iron }				
Carbon Black	285	1.0	9.5	Yes
Coal Cleaning				
Coke (By-Product)				
Cotton-Ginning				
Ferro-Alloy				
Grain Milling				
Flour Mills				
Elevators				
Nitric Acid				
Phosphate Fertilizers				
Manufacture				
Granulation				
Phosphoric Acid				
Rendering				
Soap and Detergent				
Sulfuric Acid				
Lime				

TABLE 18-C Continued

INVENTORY OF EMISSIONS(a)

CARBON MONOXIDE	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of This Pollutant Per Source 1000 T/Yr.	Candidate for Measurement Instruments for Continuous Monitoring
(Continued)				
Asphalt Batching				
Aluminum				
Secondary Non-Ferrous				
Copper				
Lead and Zinc				
Petroleum Storage				
Industrial Boilers				
Commercial-Institutional Heating Plants				
Residential Plants				
Municipal Incinerators				Yes
Other Incinerators				

(a) Emission data obtained from reference 8, Tables 3.2 and 3.8, and reference 9, Table 2.1.

TABLE 18-D

INVENTORY OF EMISSIONS (a)

HYDROCARBON	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	Candidate for Measurement Instruments for Continuous Monitoring
Steam-Electric Power Plants				
Cement Plants			8.7	Yes
Petroleum Refineries	1950	16.6		
Kraft-Pulp Mills				
Non-Ferrous Smelters				
Copper				
Lead and Zinc				
Iron-Steel				
Gray Iron Foundries				
Steel				
Pig-Iron				
Carbon Black				
Coal Cleaning	1500	12.8	23.1	Yes
Coke (By-Product)				
Cotton-Ginning				
Ferro-Alloy				
Grain Milling				
Flour Mills				
Elevators				
Nitric Acid				
Phosphate Fertilizers				
Manufacture				
Granulation				
Phosphoric Acid				
Rendering				
Soap and Detergent				
Sulfuric Acid				
Lime				

TABLE 18-D Continued

INVENTORY OF EMISSIONS(a)

HYDROCARBON	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	Candidate for Measurement Instruments for Continuous Monitoring
(Continued)				
Asphalt Batching				
Aluminum				
Secondary Non-Ferrous				
Copper				
Lead and Zinc				
Petroleum Storage	1100	9.3	0.04	Part
Industrial Boilers				
Commercial-Institutional Heating Plants				
Residential Plants				
Municipal Incinerators	1500(b)	12.6		Yes
Other Incinerators				No

(a) Emission data obtained from reference 8, Tables 3.2 and 3.8, and reference 9, Table 2.1.

(b) Includes all solid waste disposal.

TABLE 18-E

INVENTORY OF EMISSIONS (a)

OXIDES OF NITROGEN	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	Candidate for Measurement Instruments for Continuous Monitoring
Steam-Electric Power Plants	2975	37.7	9.1	Yes
Cement Plants				
Petroleum Refineries				
Kraft-Pulp Mills				
Non-Ferrous Smelters				
Copper				
Lead and Zinc				
Iron-Steel				
Gray Iron Foundries				
Steel				
Pig-Iron				
Carbon Black				
Coal Cleaning				
Coke (By-Product)	6	--	--	No
Cotton-Ginning				
Ferro-Alloy				
Grain Milling				
Flour Mills				
Elevators				
Nitric Acid	110	1.4	1.5	Yes
Phosphate Fertilizers				
Manufacture				
Granulation				
Phosphoric Acid				
Rendering				
Soap and Detergent				
Sulfuric Acid	23	0.3	0.1	No
Lime	21	0.3	0.2	No

TABLE 18-E Continued

INVENTORY OF EMISSIONS(a)

OXIDES OF NITROGEN	Industry Emissions of this Pollutant 1000 T/Yr.	Industry Emission as % of Total U.S. Stationary Source Emissions of this Pollutant	Average Emissions of this Pollutant Per Source 1000 T/Yr.	
(Continued)				
Asphalt Batching				
Aluminum				
Secondary Non-Ferrous				
Copper				
Lead and Zinc				
Petroleum Storage				
Industrial Boilers	2800	35.4		Part
Commercial-Institutional Heating Plants				Part
Residential Plants				
Municipal Incinerators	16	0.2	--	No
Other Incinerators				

(a) Emission data obtained from reference 8, Tables 3.2 and 3.8, and reference 9, Table 2.1.

Having selected potential candidates for continuous measurement instruments, it was then necessary to make an assumption concerning the number of instruments which might be applied at a given source. Estimating this number cannot be based solely on the current emission points (stacks, vents, etc.) at existing facilities. As emission control equipment is installed--and we have previously assumed that application of measurement instrumentation will follow the control equipment--the reduction of emission points by combining existing emission points into a common control system(s) should occur to the maximum extent consistent with plant efficiency and safety.

It is also necessary to make a judgement concerning the fraction of industry sources selected as potential candidates for measurement instruments that will in fact ever install measuring instrumentation. There are various reasons why these industry sources might not install measuring instrumentation. These include plant locations in air pollution control regions that do not require monitoring and for a relatively small number of older sources shutting down the facility rather than installing the necessary emission control equipment required to comply with the standards.

In this analysis the estimated average number of monitors per source, as shown in Tables 19-A to 19-E, is a composite number which includes our estimates of the fraction of facilities which will indeed install monitoring equipment and the number of instruments which might be required at a given source.

One additional type of market remaining to be included in the analysis is the replacement market. The useful life of instrumentation for application at stationary sources of pollutant emissions is assumed to average five years before replacement is required. The often severe environmental conditions in which the instrumentation will have to operate should result in a shorter useful life for this type of instrumentation relative to instruments used for ambient air quality measurements. In the absence of sufficient information to arrive at a yearly replacement market, the total replacement market during the decade has been assumed at 40% of the total initial purchases during this period. This replacement market is also shown in Tables 19-A to 19-E.

Control Agency Requirements: The last category of instrumentation included in the stationary source measurement instrumentation market analysis is the purchase of instrumentation by governmental control agencies to achieve a capability to monitor stationary sources to determine compliance with established air pollution codes. The requirement for control agency use is assumed to average two instruments per agency for each pollutant and additional quantities of instruments for the larger state and local agencies. Based on the 235 air pollution control regions that have been designated as of January 1971, this assumption results in an agency requirement of 500 instruments for each of the major gaseous air pollutants associated with stationary sources of emission. A higher number of particulate measurement instruments (750) and a smaller number of fluoride measurement instruments (50) have been assumed in order to reflect the number of emission sources.

One additional type of source emission measurement technique which must be considered for control agency compliance measurements during the decade is remote instrumentation. Remote instrumentation permits the "in-situ" sampling of the effluent plume from a stack while enabling the detection to occur at a distance physically removed from the stack. This technique promises to be a powerful tool for spot-check compliance measurements. Although considerably more expensive than conventional emission measurement instrumentation the potential savings in manpower suggest considerable use of this technique by the major agencies. We have assumed for this analysis that half of the control agencies will have two instruments for remote measurement of gaseous pollutants and two instruments for remote measurement of particulate pollutants. This assumption results in a demand for approximately 500 remote source measurement instruments.

TABLE 19-A

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

PARTICULATES	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Steam-Electric Power Plants	0.8(a)	1200	200	1400	600(b)	2000
Cement Plants	3	500	180	680	210	890
Petroleum Refineries	2	400	100	500	200	700
Kraft-Pulp Mills	1	120	120	240	100	340
Non-Ferrous Smelters	1	40	10	50	15	65
Copper						
Lead and Zinc						
Iron-Steel						
Gray Iron Foundries	0.8	1450	400	1850	650	2500
Steel	1	800	200	1000	350	1350
Pig-Iron (Blast Furnaces)	1	200	80	280	80	360
Carbon Black	1	29	6	35	15	50
Coal Cleaning						
Coke (By-Product)	2	120	20	140	50	190
Cotton Ginning						
Ferro-Alloy	1	50	10	60	20	80
Grain Milling						
Flour Mills	1	600	90	690	200	890
Elevators						
Nitric Acid	1	70	50	120	35	155
Phosphate Fertilizers						
Manufacture	1	220	120	340	100	440
Granulation	1	300	100	400	150	550
Phosphoric Acid	1	70	40	110	30	140
Rendering						
Soap and Detergent						
Sulfuric Acid	1	200	80	280	90	370
Lime	1	120	50	170	55	225

TABLE 19-A Continued

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

PARTICULATES (Continued)	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Asphalt Batching	0.25	350	150	500	120	620
Aluminum	1	25	20	45	10	55
Secondary Non-Ferrous	1	90	20	110	40	150
Copper						
Lead and Zinc						
Petroleum Storage						
Other Chemicals						
Industrial Boilers		1500	1500	3000	600	3600
Commercial-Institutional Heating Plants		2000	2000	4000	800	4800
Residential Plants						
Municipal Incinerators		400	450	950	200	1150
Other Incinerators		500	500	1000	200	1200

(a) Assumes all currently installed power generating units of 200 MW or greater capacity currently have adequate particulate measurements and that 80% of currently installed units less than 100 MW will be candidates for measurement.

(b) Includes additional 300 instruments for replacement of currently installed particulate measurement instrumentation in generating units of 200 MW or greater capacity.

TABLE 19-B

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

SULFUR DIOXIDE	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Steam-Electric Power Plants	0.5	900	200	1100	350	1450
Cement Plants						
Petroleum Refineries	2	400	80	480	160	640
Kraft-Pulp Mills*	2	200	120	320	50	370
Non-Ferrous Smelters	2	70	20	90	30	120
Copper						
Lead and Zinc						
Iron-Steel						
Gray Iron Foundries						
Steel						
Pig-Iron						
Carbon Black						
Coal Cleaning						
Coke (By-Product)	1	30	5	35	10	45
Cotton-Ginning						
Ferro-Alloy						
Grain Milling						
Flour Mills						
Elevators						
Nitric Acid						
Phosphate Fertilizers						
Manufacture						
Granulation						
Phosphoric Acid						
Rendering						
Soap and Detergent						
Sulfuric Acid	2	400	160	560	100	660
Lime						

* Instrument will also measure H_2S and mercaptans.

TABLE 19-B Continued

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

SULFUR DIOXIDE (Continued)	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Asphalt Batching						
Aluminum						
Secondary Non-Ferrous						
Copper						
Lead and Zinc						
Petroleum Storage						
Other Chemicals		200	50	250	75	325
Industrial Boilers		200	100	300	50	350
Commercial-Institutional Heating Plants		200	100	300	50	350
Residential Plants						
Municipal Incinerators						
Other Incinerators						

TABLE 19-C

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

CARBON MONOXIDE	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Steam-Electric Power Plants						
Cement Plants						
Petroleum Refineries	1	200	40	240	80	320
Kraft-Pulp Mills	1	120	60	180	50	230
Non-Ferrous Smelters						
Copper						
Lead and Zinc						
Iron-Steel						
Gray Iron Foundries	0.2	400	400	800	1300(a)	2100
Steel						
Pig-Iron						
Carbon Black	1	30	5	35	10	45
Coal Cleaning						
Coke (By-Product)						
Cotton-Ginning						
Ferro-Alloy						
Grain Milling						
Flour Mills						
Elevators						
Nitric Acid						
Phosphate Fertilizers						
Manufacture						
Granulation						
Phosphoric Acid						
Rendering						
Soap and Detergent						
Sulfuric Acid						
Lime						

TABLE 19-C Continued

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

CARBON MONOXIDE (Continued)	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Asphalt Batching						
Aluminum						
Secondary Non-Ferrous						
Copper						
Lead and Zinc						
Petroleum Storage						
Industrial Boilers						
Commercial-Institutional Heating Plants						
Residential Plants						
Municipal Incinerators	1	400	450	950	200	1150
Other Incinerators						

(a) Includes replacement of all currently installed instruments.

TABLE 19-D

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

HYDROCARBONS	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Steam-Electric Power Plants						
Cement Plants						
Petroleum Refineries	2	600	100	700	200	900
Kraft-Pulp Mills						
Non-Ferrous Smelters						
Copper						
Lead and Zinc						
Iron-Steel						
Gray Iron Foundries						
Steel						
Pig-Iron						
Carbon Black						
Coal Cleaning						
Coke (By-Product)	2	135	20	155	50	205
Cotton-Ginning						
Ferro-Alloy						
Grain Milling						
Flour Mills						
Elevators						
Nitric Acid						
Phosphate Fertilizers						
Manufacture						
Granulation						
Phosphoric Acid						
Rendering						
Soap and Detergent						
Sulfuric Acid						
Lime						

TABLE 19-D Continued

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

HYDROCARBONS (Continued)	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Asphalt Batching						
Aluminum						
Secondary Non-Ferrous						
Copper						
Lead and Zinc						
Petroleum Storage	0.05	1500	500	2000	100(a)	2100
Other Chemicals	1	300	200	500	100	600
Industrial Boilers						
Commercial-Institutional Heating Plants						
Residential Plants						
Municipal Incinerators	1	450	450	900	175	1075
Other Incinerators	0					

(a) Low replacement value reflects favorable operational conditions for instrumentation monitoring hydrocarbon emissions at petroleum storage and transfer locations.

TABLE 19-E

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

OXIDES OF NITROGEN	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units
Steam-Electric Power Plants	0.8	1400	300	1700	400(1)	2100
Cement Plants						
Petroleum Refineries						
Kraft-Pulp Mills						
Non-Ferrous Smelters						
Copper						
Lead and Zinc						
Iron-Steel						
Gray Iron Foundries						
Steel						
Pig-Iron						
Carbon Black						
Coal Cleaning						
Coke (By-Product)						
Cotton-Ginning						
Ferro-Alloy						
Grain Milling						
Flour Mills						
Elevators						
Nitric Acid	2	160	100	260	60	320
Phosphate Fertilizers						
Manufacture						
Granulation						
Phosphoric Acid						
Rendering						
Soap and Detergent						
Sulfuric Acid						
Lime						

TABLE 19-E Continued

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

OXIDES OF NITROGEN (Continued)	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Asphalt Batching						
Aluminum						
Secondary Non-Ferrous						
Copper						
Lead and Zinc						
Petroleum Storage						
Other Chemicals		200	100	300	50	350
Industrial Boilers		1500	1500	3000	600(1)	3600
Commercial-Institutional Heating Plants		2000	2000	4000	800(1)	4800
Residential Plants						
Municipal Incinerators						
Other Incinerators						

TABLE 19-F

ESTIMATED PURCHASES OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION: 1970-1980

FLUORIDE	Estimated Number of Monitors Per Existing Source (Average)	Estimated Instr. for Existing Sources	Estimated Instr. for New Sources	Total Initial Purchase 1971-80	Replacement at 40% of Instr. for Existing Sources 1971-80	Total Market (Units)
Carbon Black						
Coal Cleaning						
Coke (By-Product)						
Cotton-Ginning						
Ferro-Alloy						
Grain Milling						
Flour Mills						
Elevators						
Nitric Acid						
Phosphate Fertilizers	1	200	100	300	100	400
Manufacture						
Granulation	1	70	40	110	30	140
Phosphoric Acid						
Rendering						
Soap and Detergent						
Sulfuric Acid						
Lime						
Asphalt Batching	1	25	20	45	10	55
Aluminum						
Secondary Non-Ferrous						
Copper						
Lead and Zinc						
Petroleum Storage						

Market Estimates

This section of the report presents the estimated market for the purchase of stationary source emission measurement instrumentation during the period 1970-1980. Tables 20 and 21 summarize the market estimates for both the initial and total purchases during the decade and Tables 22 and 23 present a more detailed breakout of the market for monitoring instruments.

The market analysis includes instrumentation required for monitoring stationary source emissions for the following air pollutants: particulates, sulfur dioxide, oxides of nitrogen, hydrocarbons, carbon monoxide and fluorides. The analysis does not include potential instrumentation needs for measurement of polynuclear organic matter, lead and odors. At this time, the approach to measurements of polynuclear organic matter and odors has not been sufficiently defined to enable realistic projections of needs. It is conceivable that odor measurements, if made at the source of emission, could be based on measuring specific chemical species or classes of compounds associated with odors from a particular source. This could result in a decrease in the number of sulfur dioxide measuring instruments and their replacement with an instrument capable of measuring hydrogen sulfide (H_2S) and mercaptans in addition to sulfur dioxide.

This analysis of the market does not include the potential market for instrumentation to measure the emission of hazardous agents. It also does not include the market for pollutants not presently covered or expected to be covered by either national ambient air quality standards or as hazardous agents (see third group of pollutants on page 30).

The market analysis does not include the sales of measurement instrumentation to support the extensive research, development and demonstration programs which will be required to develop air pollution control technology.

The market analysis also contains a category called sampling devices and accessories, which includes probes, sampling trains and other accessories required to obtain a sample from a stationary source of emission and lead the sample to the measuring instruments. The average number of sampling devices required has been assumed at 0.5 units per source at which measurements are required, irrespective of the number of different pollutants to be measured. This average takes into account that many of the instruments developed for stationary source emission measurement will include a sampling system integral to the instrumentation, thereby eliminating the requirement for separate sampling devices.

TABLE 21

TOTAL PURCHASE OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION (UNITS)

(Summary Table)

	Part.	SO_2	NO_x	HC	CO	F	Sampling Devices & Accessories
Monitoring Instruments							
Total Industrial	22870	4310	11170	4880	3845	595	11500
Control Agencies	1050	700	700	700	700	75	500
Total Market	23920	5010	11870	5580	4545	670	12000

	Part.	Gaseous Pollutants
Remote Instruments	250	250

TABLE 20

INITIAL PURCHASE OF STATIONARY SOURCE MEASUREMENT INSTRUMENTATION (UNITS)

(Summary Table)

	Part.	SO_2	NO_x	HC	CO	F	Sampling Devices & Accessories
Monitoring Instruments							
Total Industrial	18050	3435	9260	4255	2205	455	8500
Control Agencies	750	500	500	500	500	50	350
Total Market	18800	3935	9760	4755	2705	505	8850

	Part.	Gaseous Pollutants
Remote Instruments	250	250

TABLE 22

INITIAL PURCHASES OF STATIONARY SOURCE MONITORING INSTRUMENTATION 1971 -1980 (UNITS)

(Detailed Table)

	Part.	SO_2	NO_x	HC	CO	F
Steam-Electric Power Plants	1400	1100	1700			
Cement Plants	680					
Petroleum Refineries	500	480		700	240	
Kraft-Pulp Mills	240	320			180	
Non-Ferrous Smelters (Copper, Lead and Zinc)	50	90				
Iron-Steel						
Gray Iron Foundries	1850				800	
Steel	1000					
Pig-Iron (Blast Furnaces)	280					
Carbon Black	35				35	
Coal Cleaning						
Coke (By-Product)	140	35		155		
Cotton-Ginning						
Ferro-Alloy	60					
Grain Milling						
Flour Mills	690					
Elevators						
Nitric Acid	120		260			
Phosphate Fertilizers						
Manufacture	340					300
Granulation	400					
Phosphoric Acid	110					110
Rendering						
Soap and Detergent						
Sulfuric Acid	280	560				
Lime	170					

TABLE 22 Continued

INITIAL PURCHASES OF STATIONARY SOURCE MONITORING INSTRUMENTATION 1971-1980 (UNITS)

(Detailed Table)

	Part.	SO_2	NO_x	HC	CO	F
Asphalt Batching	500					
Aluminum	45					45
Secondary Non-Ferrous	110					
Copper						
Lead and Zinc						
Petroleum Storage				2000		
Other Chemicals		250	300	500		
Industrial Boilers	3000	300	3000			
Commercial-Institutional Heating Plants	4000	300	4000			
Residential Plants						
Municipal Incinerators	950			900	950	
Other Incinerators	1000					

TABLE 23

TOTAL PURCHASES OF STATIONARY SOURCE MONITORING INSTRUMENTATION 1971-1980 (UNITS)

(Detailed Table)

	Part.	SO_2	NO_x	HC	CO	F
Steam-Electric Power Plants	2000	1450	2100			
Cement Plants	890					
Petroleum Refineries	700	640		900	320	
Kraft-Pulp Mills	340	370			230	
Non-Ferrous Smelters (Copper, Lead and Zinc)	65	120				
Iron-Steel						
Gray Iron Foundries	2500				2100	
Steel	1350					
Pig-Iron (Blast Furnaces)	360					
Carbon Black	50				45	
Coal Cleaning						
Coke (By-Product)	190	45		205		
Cotton-Ginning						
Ferro-Alloy	80					
Grain Milling						
Flour Mills	890					
Elevators						
Nitric Acid	155		320			
Phosphate Fertilizers						
Manufacture	440					400
Granulation	550					
Phosphoric Acid	140					140
Rendering						
Soap and Detergent						
Sulfuric Acid	370	660				
Lime	225					

TABLE 23 Continued

TOTAL PURCHASES OF STATIONARY SOURCE MONITORING INSTRUMENTATION 1971-1980 (UNITS)

(Detailed Table)

	Part.	SO_2	NO_x	HC	CO	F
Asphalt Batching	620					
Aluminum	55					55
Secondary Non-Ferrous	150					
Copper						
Lead and Zinc						
Petroleum Storage				2100		
Other Chemicals		325	350	600		
Industrial Boilers	3600	350	3600			
Commercial-Institutional Heating Plants	4800	350	4800			
Residential Plants						
Municipal Incinerators	1150			1075	1150	
Other Incinerators	1200					

6. MOBILE SOURCE EMISSION MEASUREMENTS

Mobile sources of air pollution consist of discrete sources of air pollution that are recognized as significant contributors to the deterioration of local air quality, particularly in urban areas and along the interstate freeways. In common with stationary sources of pollution, they are discrete sources but they have their own special characteristics which require special measurement tools and techniques to monitor their emissions. This section of the report is concerned with the type and quantity of instrumentation which will be required to measure the emissions from mobile sources, particularly the automobile.

Characteristics of the Market

The market for mobile source emission measurement instrumentation is a latent market,i.e., the need for such instrumentation is evident but a market for instrumentation must await the development of suitable measurement hardware and testing procedures. In estimating the market for this class of measuring instrumentation, the following market characteristics have been analyzed:

(1) Measurement requirements
(2) Legal basis for measurement requirements
(3) User of instrumentation

Measurement Requirements: The need for mobile source emission measurement instrumentation is tied to a program to control the emissions from mobile sources of air pollution, particularly the automobile. Measurement instrumentation provides a means to ascertain that control devices attached to vehicles and engines achieve emission levels consistent with established emission standards.

The emission standards for automotive vehicle/engine emissions have been designated to cover three air pollution agents: carbon monoxide, hydrocarbons and the oxides of nitrogen. In addition, the market analysis assumes the eventual control of particulates from automotive vehicles/engines. Federal emission standards currently cover the first two named pollutants and oxides of nitrogen emission control will be mandatory in 1972. The author has assumed for this analysis that particulate emission control will be mandatory in 1975.

These standards are expressed in terms of the weight of pollutant emitted per mile the vehicle is driven. Since the emissions of a given pollutant changes greatly under different driving conditions, such as idling, cruising and acceleration, a measurement to establish whether the emission standards are being met must be coupled to a test cycle that accurately reproduces the average driving pattern or as an alternative the measurement could be accomplished during a road test of the vehicle. The large number of discrete sources of emissions, some 103 million vehicles in 1968, has thus far precluded measurement on the road. The federal government, as well as certain state air pollution control agencies, have taken the lead in developing appropriate test cycles and sampling procedures which would enable measurements of emissions taken with the vehicle at a fixed location to reflect whether the emissions were in compliance with the established standards. These cycles have, in most cases, used a dynamometer (a form of inertia wheel) on which the vehicle is placed to provide engine loadings representative of on-the-road driving patterns. Some work has also been done to develop correlation between emissions recorded under engine idle and high-speed revolution without loading and the on-the-road emissions. Clearly the test cycle and sampling procedure that is selected will determine the required measurement instrumentation parameters of response time and concentration level of pollutant to be measured.

Legal Basis for Measurement Requirements: The Air Quality Act and state air pollution codes have provided considerable guidance to what type of measurements will most likely be required on emissions of air pollution agents from the automobile. The 1970 Amendment places great emphasis on measurements of automotive emissions. This discussion of the legal basis for measurements is based on the 1970 Amendments.

The 1970 Amendments provide for four separate checks on the emissions from the automobile vehicle/engine which will require measurement of emissions. These are certification testing, surveillance testing, quality assurance testing and inspection testing. Certification testing is applied to new vehicles/engines while surveillance testing and inspection testing are applied to vehicles in general use.

Certification and surveillance (11h and 11i) testing will be primarily federal government responsibilities and while they will involve extensive emission testing they will be applied to a relatively small sample population of vehicles/engines and will not represent a major market for mobile source emission measurement instrumentation.

The current California state air pollution code requires that new motor vehicles entering the state after 1970 be measured for emissions by the manufacturer to ascertain that they conform with the state automotive emission standards. The 1970 Amendments authorize testing to determine that production models meet the emissions levels for which prototype vehicles/engines were certified during the federal certification tests (11j).

The periodic inspection of vehicles in general use to determine if they continue to meet that emission standards under which they were certified is not currently required by legislation except for surveillance testing of a relatively small population sample by the federal government. Air pollution codes in several states require such periodic testing once technically feasible methods of testing are developed and some states, such as New Jersey and California, are conducting demonstration test programs to develop and prove the worth of such methods. The 1970 Amendments provide for grant funds to assist the states in developing and maintaining a periodic inspection program to determine the compliance of vehicles and emission control systems with the automotive emission standards. In addition, the 1970 Amendments require that the state plans to implement air quality standards in their regions include to the extent necessary and practicable an approach for periodic inspection of motor vehicles in general use (11 m).

Users of Instrumentation: The users of mobile source emission measurement instrumentation fall into three sections of the economy: governmental control agencies, the automotive industry, and the automotive service and repair area.

Governmental control agencies, at the state and local level, will be responsible for the periodic inspection of vehicles in general use. In this responsibility, they, or agents to whom they designate this responsibility, will be the customers for inspection instrumentation and systems. The automotive indstry will probably be responsible for conducting assembly line inspection testing of vehicles/engines. The automotive service and repair area is regarded as a customer for auto emission monitoring instrumentation to provide measurements in support of services required to return vehicles and control devices that have failed the periodic inspection to an operational condition that will meet the emission standards.

Method Used to Estimate the Market

This section of the report will consider the method used to estimate the market for mobile source emission measurement instrumentation for each of the three sectors of the market identified in the previous section.

Periodic Inspection of Vehicles in General Use

The periodic inspection of vehicles in general use will be performed either by a state or by some group to whom it delegates this authority. It seems reasonable to assume that such periodic measurements will be combined with the highway safety inspection programs and that the measurements will be performed either in a state operated vehicle safety inspection facility, such as those operated by New Jersey, Delaware, and the District of Columbia or in an automotive repair or service facility that currently is licensed to conduct the periodic state highway safety inspection.

In estimating the number of inspection facilities required to conduct an adequate periodic inspection of vehicle emissions, it has been assumed that a minimum of once a year inspection will be required. Once a year inspection is average for the highway safety inspection program, and we have already indicated that it is likely that the auto emission inspection will be tied to existing highway safety inspection programs.

In estimating the market, we have considered two alternative auto exhaust emission inspection procedures. The first alternative provides a lower boundary on the number of facilities and hence the number of instruments required by calculating the number of state operated inspection facilities that would be required to inspect on a once a year basis every motor vehicle registered in the United States. This calculation involved extrapolating the existing plans of the State of New Jersey for automotive inspection. The New Jersey plan would involve installing one set of measurement devices in each of the state's current 78 auto safety inspection lanes. One such measurement system has been in operation for the past year and four additional systems are being installed to obtain additional operating experience before a final decision is reached on the state auto emissions inspection program in mid-1971. The current average length of time that a motor vehicle takes to traverse the New Jersey highway safety inspection program is 90 seconds and it does not seem likely that a meaningful auto emission program could be conducted in less than this elapsed time period. Based on New Jersey's automobile registration of 3,448,000 units in 1969 and a total U.S. registration of 104,702,000 units in the same year, a nationwide minimum of 2,450 inspection complexes was calculated. This minimum value was increased to 2,850 inspection complexes to account for a sparcer automotive population in some parts of the U.S. which would require a larger number of inspection facilities per unit vehicle population. This represents the probable number of inspection complexes needed to meet current auto emission inspection requirements. Using an estimate U.S. automotive registration of 153,000,000 units in 1980, an additional one-thousand inspection complexes will be required during the decade.

Each inspection complex is assumed to contain instrumentation capable of measuring the four pollution agents for which we have assumed auto emission standards will be designated and a dynamometer or other suitable device to subject the vehicle/engine to a load consistent with the test cycle that is selected.

The second alternative involves conducting similar periodic inspections in a facility, such as an automotive service station or repair facility, licensed by the state to conduct the automotive emission inspection. We estimate that such an inspection procedure would increase the number of emission inspection facilities required per unit vehicle population by several-fold.

Adjustment and Repair of Automotive Emission Control Devices

A periodic automotive emission inspection program is unlikely unless it is accompanied by regulations requiring correction of faulty vehicles, engines and emission control devices. These corrections will require monitoring instruments to enable a repair or service facility to make adjustments to the vehicle and/or control devices which will enable them to meet the emission standards.

This analysis of the market assumes that repair or service facilities will only purchase instrumentation to measure the level of hydrocarbon and carbon monoxide emissions in automotive exhaust. The measurement of these two pollutants could be valuable in reducing emissions by providing information needed to improve engine adjustments. Instruments that enable both of these pollutants to be measured are currently available at $800-1000 per unit. We have assumed that no instrumentation will be required by repair or service facilities for measuring nitrogen oxide emissions, although a market for instruments to measure this pollutant could develop if the devices installed for nitrogen oxide emission control are amendable to service station adjustment.

The number of facilities who are potential customers for such instrumentation is based on the number of automotive repair facilities and service stations in the U.S. and the anticipated growth in this sector assuming that the ratio of service/repair facilities per unit vehicle population remains constant. The required emission control adjustments are in the nature of vehicle/engine tune-ups, a capability currently available at most repair facilities and at many service stations. The market estimate for this sector of the market assumes 70% of the automotive repair facilities and 25% of the service stations will purchase instrumentation to measure hydrocarbon and carbon monoxide emissions from the automobile.

Assembly-Line Testing

The market for assembly-line testing assumes that the authority to require the manufacturers to test new vehicle production to determine if new motor vehicles being manufactured do in fact conform with the regulations with respect to which the certificate of conformity was issued will be applied (11$_j$).

The initial purchase of assembly line emission test units in the U.S. during the decade has been estimated based on the number of automotive assembly lines in 1970, the additional new vehicle production in 1980, the anticipated increase in assembly rate, and the number of instrumentation complexes required per assembly line to conduct the required performance testing. We have assumed that five instrumentation complexes will be required per assembly line; a quantity of instrumentation which will enable performance testing of 10 to 15% of the new vehicle production using the current 23-minute certification cycle.

Market Estimates

This section of the report presents the estimated market for automotive emission measurement instrumentation during the period 1971-1980. Tables 24 to 26 present the market for automotive emission inspection instrumentation using state operated facilities. Tables 27 and 28 present similar market analysis data for an alternate inspection procedure where the inspections are conducted in state franchised stations. Tables 29 and 30 cover the service area instrumentation requirements. Tables 31 and 32 cover the assembly line emission testing market.

Table 24

Mobile Source Emission Measurement

AUTOMOTIVE EMISSION INSPECTION

Alternate I - State Operated Facilities

Station Requirement:

Basis: (1) Nationwide annual inspection of each motor vehicle in a state owned and operated inspection facility.

(2) Vehicle inspection lane requirement assumed similar to State of New Jersey highway inspection system.

78 Lanes(a) for 3,448,000 vehicles(b)

(3) U.S. motor vehicle registration

1969	104,702,000(b)
1970	108,500,000(c)
1980	153,000,000(c)

Estimate of Station Requirement:

1970 $78 \times \frac{108.5}{3.45} = 2450$ stations

1980 $78 \times \frac{153.0}{3.45} = 3460$ stations

Station Requirement Assumed for Market Analysis(d)

1970 - 2850 stations

1980 - 3860 stations

Source: (a) State of New Jersey
(b) Reference 3
(c) Reference 4

(d) Assumes an additional 400 stations required to adequately service less densely populated states.

Table 25

Mobile Source Emission Measurement

AUTOMOTIVE EMISSION INSPECTION

Alternate I - State Operated Facilities

Probable Station Components:

Component	No. per Station(a)	Probability of Station Having Component	Estimated Cost*
Sampling Device	1.1	1	1000
Analyzers			
Carbon Monoxide	1.1	1	2000
Hydrocarbon	1.1	1	2000
Nitrogen Oxides	1.1	1	2000
Particulates	1.1	1	3000
Dynamometer	1.1	1	1000

- - - - -

(a) Assumes 10% spares as average over all facilities.

* The reader is referred to Section 7, beginning on page 82, for a discussion of probable instrumentation cost.

Table 26

AUTOMOTIVE EMISSION INSPECTION

Alternate I - State Operated Facilities

Market Estimate: 1971-80

Component	Initial Purchases	Replacement(a) Purchases	Total Market
Sampling Device	4240	2120	6360
Analyzers			
Carbon Monoxide	4240	2968	7208
Hydrocarbons	4240	2968	7208
Nitrogen Oxides	4240	2544	6784
Particulates	4240	--	4240
Dynamometer	4240	--	4240

(a) Replacement market estimated to follow assumptions outlined in Table 8. Assumes initial nitrogen oxide analyzer installations by 1974 and particulates analyzer installation by 1976.

Table 27

AUTOMOTIVE EMISSION INSPECTION

Alternate II - Inspection in State Franchised Station

Station Requirement:

Basis: (1) Assumed maximum inspection rate of 4000 vehicles per station per year.

(2) Nationwide annual inspection of all motor vehicles.

(3) U.S. motor vehicle registrations.

1970	108,500,000 (a)
1980	153,000,000 (a)

Estimate of Station Requirement:

1970 108.5 $\overline{M}$/4000 = 27,100 stations

1980 153.0 $\overline{M}$/4000 = 35,750 stations

Probable Station Components:

Component	No. Per Station	Estimated Cost*
Analysers		
Hydrocarbon-Carbon monoxide (Combined)	1	$1000
Nitrogen Oxides	1	750
Sampling Device	1	200

---

* The reader is referred to Section 7, beginning on page 82, for a discussion of probable instrumentation cost.

Source: (a) Reference 4

Table 28

AUTOMOTIVE EMISSION INSPECTION

Alternate II - Inspection in State Franchised Station

Market Estimate: 1971-80

Component	Initial Purchase	Replacements(a)	Total Market
Analyzer			
Hydrocarbon-carbon Monoxide	35,750	7,150	42,900
Nitrogen Oxides	35,750	7,150	42,900
Sampling Device	35,750	--	35,750

- - - - -

(a) Replacements for analyzers assumed to be 20% of initial purchase.

Table 29

Mobile Source Emission Measurement

SERVICE AREA

Station Requirement:

Basis: (1) 57,838 general auto repair shops (1967)[a].
32,898 new motor vehicle franchised dealers (1967)[a].
216,059 gasoline service stations (1967)[a].

(2) U.S. registered motor vehicles 1967 - 104,702,000
1970 - 108,500,000
1980 - 153,000,000

(3) Assumed participation of service area in emission control system/device repair
70% general auto repair shops
80% new motor vehicle franchised dealers
25% gasoline service stations

(4) Auto service area will grow at same rate as motor vehicle registrations.

Estimate of Station Requirement:

General Auto repair	$.7 \times 57{,}838 \times \frac{153.0}{104.7} = 59{,}164$
New motor vehicle franchised dealers	$.8 \times 32{,}898 \times \frac{153.0}{104.7} = 38{,}425$
Gasoline service stations	$.25 \times 216{,}059 \times \frac{153.0}{104.7} = 78{,}862$

---

[a] Source: U.S. Department of Commerce, Bureau of the Census, 1967 Census of Business, Construction Industry and Manufacturing.

Table 30

Mobile Source Emission Measurement

SERVICE AREA

Probable Station Components:

Component	No. per Station	Estimated Cost*
Hydrocarbon-Carbon Monoxide (Combined analyzer)	1	500

Market Estimate: 1971-80

Component	Initial Purchase	Replacements(a)	Total Market
Hydrocarbon-Carbon Monoxide (Combined analyzer)	176,000	35,200	211,200

Note: If Alternate II for Automotive Inspection Testing (Use of State franchised stations) was followed the initial purchase of service area components is reduced by 35,750 components, as instrumentation for a portion of the service area would be covered under the automotive inspection testing category. Including replacements the total service area market would be reduced by 42,900 units.

- - - - -

(a) Replacements assumed to be 20% initial purchases.

* The reader is referred to Section 7, beginning on page 82, for a discussion of probable instrumentation cost.

Table 31

Mobile Source Emission Measurement

ASSEMBLY LINE EMISSION TEST UNITS

Requirement:

Basis: (1) 60-70 assembly lines in U.S. (1970)(a).

(2) Motor Vehicle assemblies per unit time per assembly line will increase from 1969 average of 55 vehicles per hour to 100 vehicles per hour(b).

(3) Assembly line capacity will grow at the same rate as projected yearly motor vehicle production rate.

(4) U.S. motor vehicle production for 1970 - 11,500,000 units(c)
1980 - 15,000,000 units(c)

(5) Assumes 5 instrumentation complexes per assembly line.

Estimate of Instrumentation Complexes for Assembly Lines - 1980

$$\begin{matrix}\text{Number of}\\ \text{Assembly Lines}\\ \text{1970}\end{matrix} \times \begin{matrix}\text{Production}\\ \text{Ratio}\\ \text{1970-1980}\end{matrix} \times \begin{matrix}\text{Assembly Rate}\\ \text{Ratio}\\ \text{1970-1980}\end{matrix} \times \begin{matrix}\text{Instrumentation Complexes}\\ \text{Per Assembly Line}\end{matrix} =$$

Instrumentation Complexes Required in 1980

$$65 \times \frac{15\bar{M}}{11.5\bar{M}} \times \frac{55}{100} \times 5 = 232 \text{ instrumentation complexes}$$

(a) Based on 57 auto assembly plants.
(b) Fortune, July 1970, p. 117.
(c) Auto News, December 12, 1969.

Table 32

Mobile Source Emission Measurement

ASSEMBLY LINE EMISSION TEST UNITS

Probable Test Unit Components:

Same as State operated Automotive emission testing (see Table 23).

Market Estimate (1971-1980):

Component	Initial Purchases	Replacements(a)	Total Market
Sampling Device	232	93	325
Analyzers			
Carbon Monoxide	232	93	325
Hydrocarbon	232	93	325
Nitrogen Oxides	232	93	325
Particulates	232	93	325
Dynamometer	232	93	325

(a) Replacements estimated at 40% of initial purchases.

7. DOLLAR VALUE FOR THE MARKET

An estimate of the dollar value of the market for air pollution measurement instrumentation during the period 1971-1980 is presented in this section. The author recognizes that estimating the dollar value of the market is an uncertain undertaking as it is extremely sensitive to the price assumed for a unit of instrumentation. However, many of the users of this report will find a dollar value analysis of the market useful, and we present such an analysis clearly stating the assumptions that we have used. The user of the report can easily change the assumed unit price of instrumentation or other factors as he sees fit and thereby obtain a new estimate of the dollar value of the market.

The probable unit price assumed for this estimate has previously been given for ambient air quality level instrumentation (see Tables 12 and 14) and for mobile source emission measurement instrumentation (see Tables 25, 27 and 30). Before presenting the dollar value, estimates for the market justification for some of the assumed probable unit instrumentation prices are needed.

The probable ambient air quality level monitoring instrumentation unit price has been assumed to be $4000 for a gaseous pollutant analyzer including a simple recorder.* The assumed price for the gaseous pollutant analyzer is considerably higher than the advertised price of many recently introduced ambient air quality analyzers, although it is very close to the advertised price of similar instruments sold by established companies in the industry. It is our opinion that the pricing of instrumentation by the established companies in the industry is closer to the probable future price for ambient air quality monitoring instrumentation, and that the price advertised by many of the new entrants to this field does not adequately reflect the high cost of marketing the instrumentation and providing technical service to limited and widely-scattered customers each purchasing but a few units of a particular analyzer.

A unit price of $500 has been assumed for gas collection devices used for collecting samples of gaseous pollutants to measure trends in air pollution. This unit price is based on current prices for a sequential gas bubbler collection system. Improved trend measurement instrumentation is currently under development, but present estimates of the cost of such instrumentation is in the range of $1500-2500 per unit. We do not expect that the funding availability for purchase of this type of equipment by control agencies will support the required number of trend measurement instruments at a price much in excess of $500.

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* All instrumentation prices given in this report are 1970 prices. No attempt has been made to consider potential price increases during the decade due to inflation or potential price decreases resulting from technological improvements.

The probable stationary source emission measurement instrumentation unit price has also been estimated to be $4000 including a simple recorder, but for different reasons. Again the potential customers will be purchasing only a few analyzers, in many cases but a single analyzer. Many more potential customers, however, are located in an area accessible to a marketing and technical service team which should lead to a more effective sales organization and hence lower marketing costs. These savings are offset by the increased complexity of instrumentation capable of operating under the adverse environmental conditions found in source emission measurement. Even at the assumed cost for source emission measurement instrumentation, the cost represents a relatively small value compared to the cost of the emission abatement equipment that the measurement instrumentation will assist to control.

Instrumentation for remotely measuring particulate or gaseous pollutants emitted from stationary sources is estimated to cost $25,000 per unit.

The probable mobile source emission measurement instrumentation assumed unit price is quite variable. Looking first at instrumentation for auto exhaust emission inspection testing, we find that analyzers covering, in many instances, a pollutant concentration level range similar to that of stationary source emission measurement instrumentation are priced $2000 lower. This reflects the less severe environmental conditions in which the instrument must operate and the savings in marketing costs associated with one-time large quantity purchases over a short time period.

The instrumentation for the service area component of the market is assumed to be low price instrumentation. This assumption is based on the price that can be paid for an instrument to be used in making minor adjustments to vehicle engines and control devices to insure an improvement in their performance as pollution abatement systems as compared to the probable extra charge that can be passed on to the vehicle owner.

One further danger in providing a dollar value estimate of the market results from the long market period that we are considering relative to the anticipated life of instrumentation. The market period of ten years results in a considerable replacement market. Some users of this report may want to make assumptions concerning the replacement rate for instrumentation that differ from those made in this analysis. In an effort to assist these users the dollar value estimates for the market are presented for both the total market during the decade and for the initial purchase market.

TABLE 33

MEASUREMENT INSTRUMENTATION TOTAL PURCHASE MARKET VALUE ESTIMATE: 1971-1980(a)

($1000)

Analyzers	Ambient Air Quality Level Monitoring CAM	Ambient Air Quality Level Monitoring Trend Indicator	Stationary Source Emission Measurement	Mobile Source Emission Measurement Inspection(b) and Assembly Line	Mobile Source Emission Measurement Service Area
Particulates	2000	6925	95,680	13,690	
Sulfur dioxide	5684	↑	20,040		
Carbon monoxide	5528		18,180	15,066	105,600
Hydrocarbons	6080		22,320	15,066	
Nitrogen Dioxide	5576	13208	47,480	14,218	
Nitric Oxide	4544				
Oxidants	5736				
Odors	5168				
Fluorides	1520	↓	2,680		
Polynuclear organic matter	1970				
Remote Instrumentation					
Particulates			6,250		
Gaseous pollutants			6,250		
Sampling Devices & Accessories	--	--	24,000	11,250	
	43,796	20,133	242,880	69,290	105,600

(a) Total market value including initial purchases and replacements.

(b) Inspection market estimate for this table is based on state operated emission inspection stations (Alternate I).

TABLE 34

MEASUREMENT INSTRUMENTATION
INITIAL PURCHASE MARKET VALUE ESTIMATE: 1971-1980

($1000)

	Ambient Air Quality Level Monitoring		Stationary Source Emission Measurement	Mobile Source Emission Measurement	
Analyzers	CAM	Trend Indicator		Inspection(a) and Assembly Line	Service Area
Particulates	2000	3952	75,200	13,416	
Sulfur dioxide	2684	↑	15,740		
Carbon monoxide	2888		10,820	8,944	88,000
Hydrocarbons	3800		19,020	8,944	
Nitrogen Dioxide	2976		39,040	8,944	
Nitric Oxide	2504	8419			
Oxidants	3256				
Odors	3468				
Fluorides	1520		2,020		
Polynuclear organic matter	1520	↓			
Remote Instrumentation					
Particulates			6,250		
Gaseous pollutants			6,250		
Sampling Devices & Accessories	--	--	17,700	8,944	
	26,616	12,371	192,040	49,192	88,000

( ) Inspection market estimate for this table is based on Alternate I.

8. TIME FRAME FOR THE MARKET

The market growth rate for each of the market areas will not be uniform over the decade. As shown in Figure 1, the market for ambient air quality monitors and for auto emission measurement instruments should reach maturity during the decade and begin to decrease.

Ambient Air Quality Monitoring

The market for ambient level measurement instrumentation is expected to have its period of pronounced growth in the next few years, reaching its peak in 1975, and trailing off thereafter to a replacement level during the remainder of the decade. This estimate is based on the early designation of control regions by the federal government which should enable establishment of the majority of control programs within the coming year. Following an initial period of purchasing instruments to set up their monitoring networks, which we estimate will be completed in 1974, we anticipate that the yearly market for this area of instrumentation will be considerably reduced in the remainder of the decade.

Stationary Source Emission Measurements

The market for source emission measurement which accounts for the major segment of the total instrumentation market during the decade is expected to have a slow but very impressive growth. The slow growth that we postulate is based on the hypothesis that routine monitoring of stationary source emissions will not be required until control techniques are installed. Once control techniques are installed source emission monitoring will enable both the tabulation and recording of the emission rate and function as part of the feedback loop for pollution emission control. We expect that air pollution control techniques will be widely installed by the end of the decade and that the general application of source emission monitoring will follow the technology application.

Auto Emission Measurements

As we pointed out earlier the market for auto emission inspection and testing instrumentation is based on our assumption that the states will conduct annual automotive emission inspections to assure that the air pollution control equipment on automobiles is in effective working order. We estimate that the agency segment of this market will peak in 1977, although the peak could occur anywhere in the 1975-78 period. One of the reasons for the projected rapid growth of this market is the increasing probability that additional federal grant funds will be made available to the states to implement an inspection and testing program (11 ℓ). Once these federal funds are made available we foresee a very short period in which the states will establish inspection and emission testing facilities. The market during the remainder of the decade will be limited to instrumentation replacement and expansion of the inspection facilities.

The service area segment of the market will follow the establishment of the state inspection and emission testing programs as the need for a capability to make minor adjustments to the engine and the control devices to insure an improvement in their performance as a pollution abatement system is recognized. This segment of the market should reach its peak within two years following the peaking in the agency segment of the market.

Industry purchases of instrumentation to perform emission quality assurance testing by the auto manufacturers is expected to be completed by 1975.

TABLE 35

TIME FRAME FOR THE INSTRUMENTATION MARKET
SUMMARY BY MEASUREMENT AREAS

Million Dollars per Year

Year	Ambient Air Quality Level Monitoring	Stationary Source Emission Measurement	Auto Exhaust Emission Measurement	Totals
1971	3	4	1	8
1972	4	6	3	13
1973	7	10	9	26
1974	11	14	15	40
1975	12	22	26	60
1976	7	27	30	64
1977	3	32	31	66
1978	4	38	26	68
1979	5	44	19	68
1980	6	46	15	67
Totals	62	243	175	480
%	13	51	36	100

TABLE 36

TIME FRAME FOR THE INSTRUMENTATION MARKET SUMMARY BY MEASUREMENT AREAS

Million Dollars per Year

Year	Agency	Industry	Automotive Service Area	Totals
1971	4	4	--	8
1972	7	5	1	13
1973	12	9	5	26
1974	20	12	8	40
1975	30	18	12	60
1976	25	23	16	64
1977	18	28	20	66
1978	14	35	19	68
1979	13	40	15	68
1980	15	43	9	67
Totals	158	217	105	480
%	33	45	22	100

TABLE 37

TIME FRAME FOR THE INSTRUMENTATION MARKET

Million Dollars per Year

	Ambient Air Quality Level Monitoring			Stationary Source Emission Measurement						Auto Exhaust Emission Measurement								
	Agency			Agency			Industry			Agency			Service Area			Industry		
Year	I	R	T	I	R	T	I	R	T	I	R	T	I	R	T	I	R	T
1971	3		3				4		4	1								
1972	4		4	1		1	5		5	2		2	1		1			
1973	6	1	7	2		2	7	1	8	3		3	5		5	1		1
1974	10	1	11	3		3	9	2	11	6		6	8		8	1		1
1975	10	2	12	5		5	13	4	17	12	1	13	12		12	1		1
1976	4	3	7	3	1	4	17	6	23	12	2	14	15	1	16			
1977		3	3	3	1	4	21	7	28	8	3	11	18	2	20			
1978		4	4	3	1	4	26	8	34	3	3	6	15	4	19		1	1
1979		5	5	3	1	4	32	8	40		4	4	10	5	15			
1980		6	6	2	1	3	33	10	43		6	6	3	6	9			
TOTALS	37	25	62	25	5	30	167	46	213	47	19	66	87	18	105	3	1	4

I = Initial purchases
R = Replacement purchases
T = Total purchases

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    (e) Sec. 111 (d)(i)
    (f) Sec. 111
    (g) Sec. 112
    (h) Sec. 206 (a)(1)
    (i) Sec. 207 (c)(1)
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ADDENDUM

While this report was at the printers, the Environmental Protection Agency published two notices in the Federal Register which will affect the market for air pollution measurement instrumentation.

Part II of Volume 36, No. 158 of the Federal Register, August 14, 1971 promulgated regulations for preparation adoption and submittal of implementation plans. In item 420.17 covering air quality surveillance, the minimum frequency of sampling is promulgated. Two types of measurement techniques are called for: (1) 24-hour samples which correspond to the trend indication instrumentation described on page 16 of this report, and (2) continuous techniques described on page 15 of this report.

Part II of Volume 36, No. 159 of the Federal Register, August 17, 1971 proposed standards of performance for new stationary sources. In item 466.25, 466.53, and 466.64 continuous monitoring of emissions from selected stationary sources is proposed.

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13. ABSTRACT

The market for air pollution instrumentation during the decade of the 70's has been determined. The market analysis presented is based on the survey of instrumentation requirements conducted at the federal, state, and local level and on an analysis of current legislation and air pollution control codes. ~~We have estimated~~ the market was estimated for three areas of measurement instrumentation: ambient level monitoring, stationary source emission measurement, and auto exhaust measurement. This market amounts to nearly one-half billion dollars during the coming decade, some 76% of which represents initial purchases of air pollution measuring equipment. Industry will be the major purchaser of instrumentation accounting for 45% of the market. The market is heavily oriented towards stationary source emission measurement, this area accounting for one-half of the total instrumentation market value. It is shown that the timing is a critical factor in the market with each of the three areas of measurement reaching maturity at different periods during the decade. ( )

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Air pollution						
Measurement instrumentation						
Stationary sources of pollution						
Ambient air quality monitoring						
Auto exhaust measurement						
Value of market						
Emissions						
Nitrogen oxides						
Nitric oxides						
Nitrogen dioxide						
Sulfur dioxide						
Oxidants						
Particulates						
Fluorides						
Carbon monoxide						
Hydrocarbons						
Polynuclear organic matter						
High volume sampler						
Gas collector devices						
Dust fall collectors						

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